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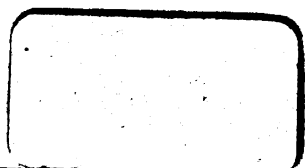
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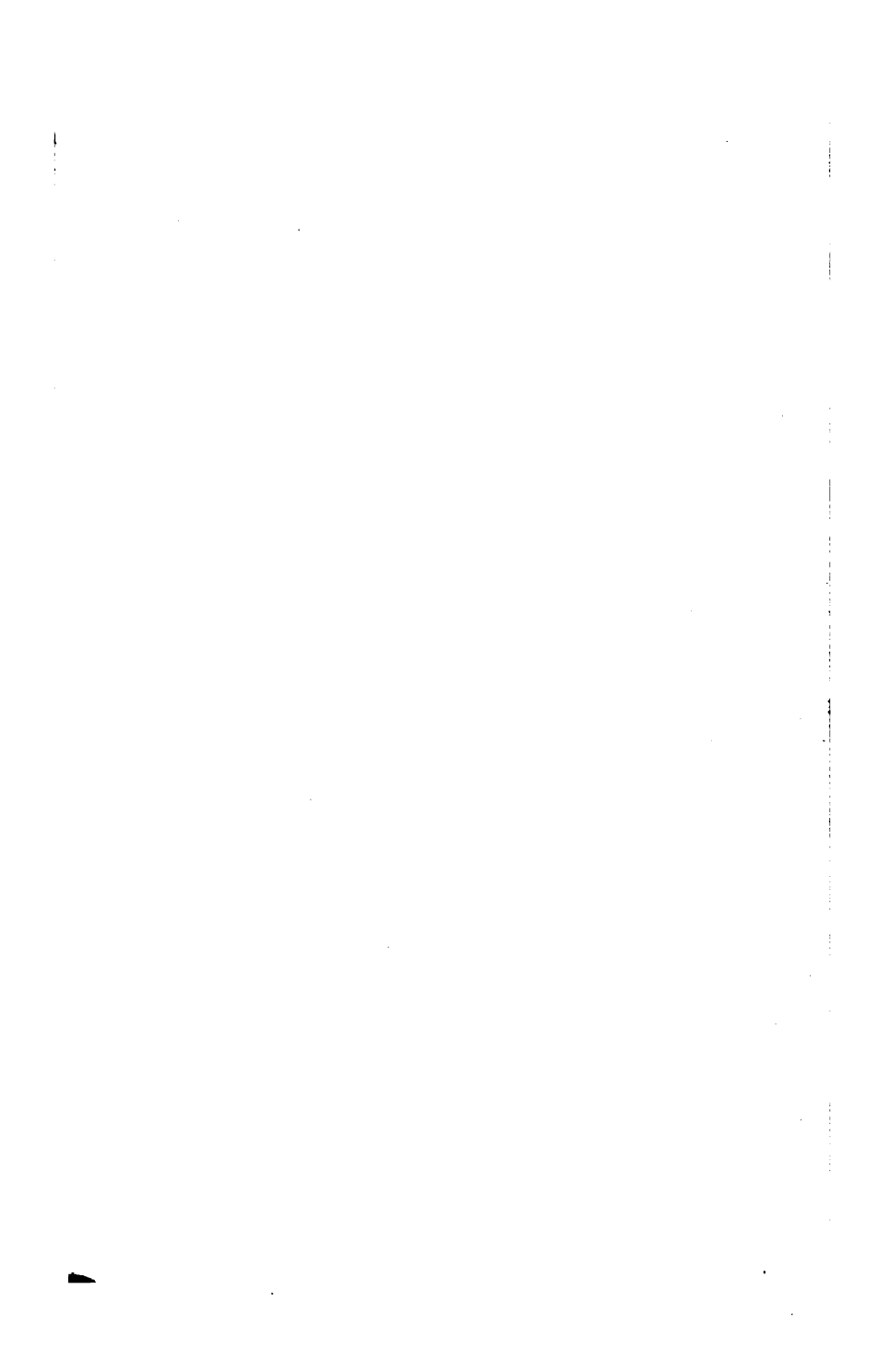
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NAVIGATION
OF THE
ATLANTIC OCEAN
CONTAINING A BRIEF ACCOUNT OF THE
WINDS, WEATHER, AND CURRENTS
PREVAILING THEREIN
ACCORDING TO THE MOST EXPERIENCED AUTHORITIES

Second Edition

WITH CHARTS

That seamen may with steam or sail
Know where to meet the favoring gale;
May take instruction from the skies,
And find the path where swiftness lies.

A. B. BECHER, CAPTAIN, R.N.,

Of the Hydrographic Office, Admiralty.

*Author of the Voyage of H.M.S. Chanticleer—The Landfall of Columbus—The Storm Compass—
Editor and Author of various Papers in the Nautical Magazine.*

London

J. D. POTTER

31, POULTRY, AND 11, KING STREET, TOWER HILL.

1859

Price Three Shillings and Sixpence.

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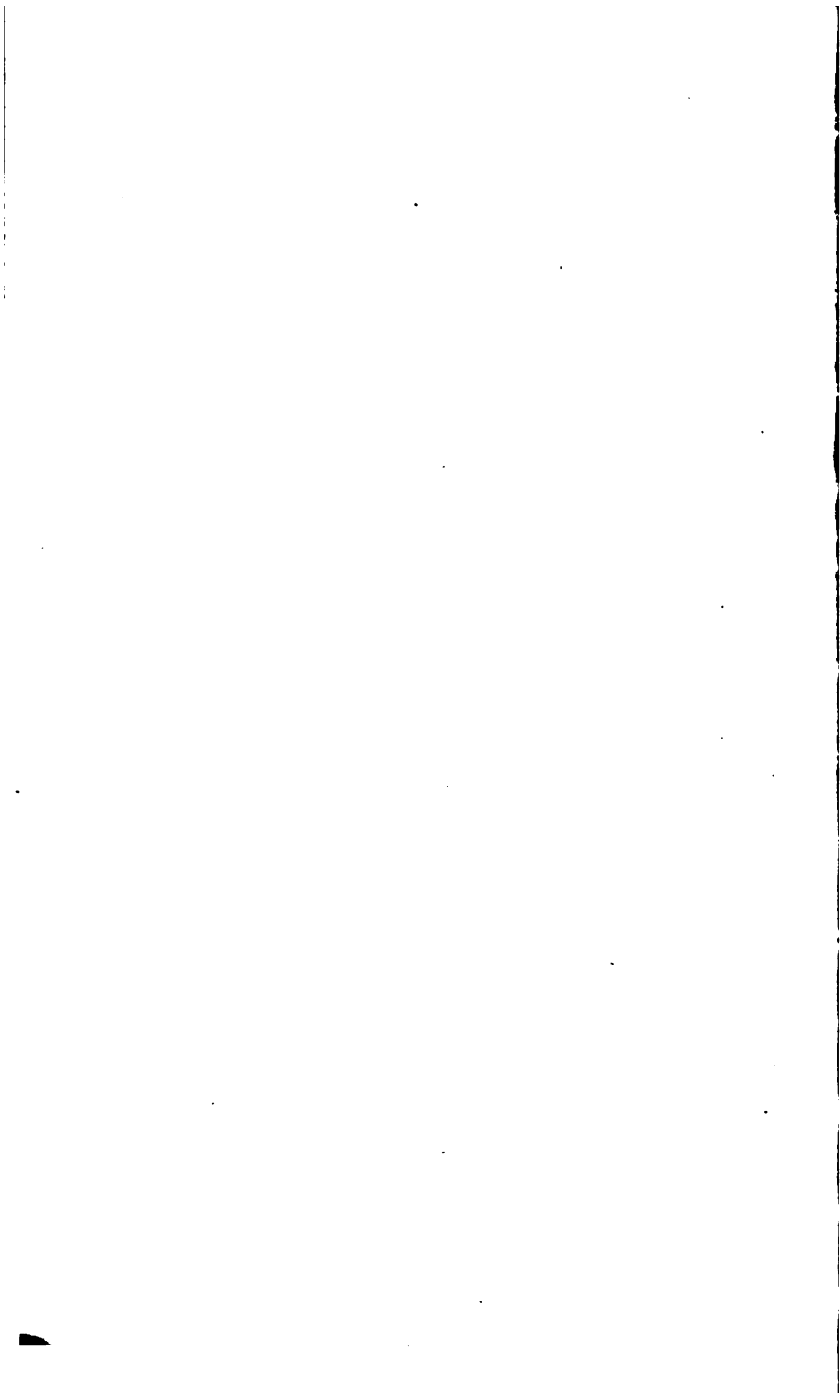
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INTRODUCTION.

THE substance of the following pages is gathered from the valuable work of Capt. KERHALLET, compiled from the voyages of the most celebrated navigators, including the more recent contributions of our mercantile commanders to the "NAUTICAL MAGAZINE." It has already appeared in that periodical, from which it has gone through a first edition. The ready manner in which that edition has been taken up, affords good promise that the present, in its still more attractive form, will prove even more acceptable.

The subjects which it embraces are of much importance to the navigator; for, next to a fair wind, to know the season at the place to which he may be bound, how to go there, and when to go with regard to weather, is most desirable:—And such is the object briefly treated in these pages.



THE ATLANTIC OCEAN.

GENERAL WINDS.

THE basin of the Atlantic Ocean, divided unequally between the West coasts of Europe and Africa and the East coast of America, presents a deep valley which appears bounded on the North and South only by the poles. Fields of ice have arrested the progress of navigators who have endeavoured to explore those regions.

In order to consider the winds common to this ocean, we shall divide it into three regions: the first, that comprised between the parallels of 30° North and South latitudes; the second between the latitude of 30° South and the South pole; the third between 30° North and the North pole. We shall divide each of these two last-named regions into two zones: the temperate zone, extending from the parallel of 30° to 60° , and the frozen zone between the latitude of 60° and the poles.

We shall first consider the winds of each of these divi-

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sage across the Atlantic, from the Old to the New World, quick and easy.

The trade winds appear to be the only primitive winds. Where they are established, the weather is always fine, and the sky generally clear. If they cease for a while, the sky becomes clouded, and, in certain parts, storms are experienced, the more lasting and severe in proportion as the places are more or less distant from the equator.

Those regions where the trade winds do not prevail, are constantly exposed to squally and tempestuous weather; where they cease only from any cause, bad weather is experienced, and it has been remarked that they always return with some violent reaction, or with torrents of rain.

The trade winds to the North and South of the equator have similar characters, as will be hereafter described.

Limits of the Trade Winds.—The polar limits of the trade winds from N.E. and S.E. generally extend on each side of the equator to the parallels of 30° North and South latitude. Nevertheless, this limitation differs greatly in some parts of the ocean; because it is influenced by temperature, and varies about 3° North or South, according as the declination of the sun is North or South.

The equatorial limit of the N.E. and S.E. trade winds is generally variable from the same causes. That of the N.E. trade is about the mean parallel of 8° North latitude; that of the S.E. trade is at the parallel of 2° or 3° North latitude.

From a numerous collection of observations, the fol-

lowing table has been formed; which, however, only affords an approximation to these limits:—

Periods of the Year.	Polar Limit of N.E. and S.E. Trade Winds.	Equatorial Limit of N.E. Trade Wind.	Equatorial Limit of S.E. Trade Wind.	Polar Limit of N.E. Trade Wind, according to the Months.
	0 /	0 /	0 /	0 /
Winter...	24 45 N. or S.	5 45 N.	2 30 N.	January. 23 24 N.
				February. 28 30
Spring....	28 0	5 45	1 30	March .. 27 19
				April .. 28 18
Summer..	30 45	11 20	3 15	May..... 28 31
				June..... 31 25
Autumn ..	28 30	10 0	3 15	July 29 26
				August .. 31 11
				September 33 4
				October.. 25 28
				November 27 14
				December 23 15

In the Atlantic Ocean, the trade wind from the N.E. in the part comprised between Cape Verd and the coast of Guinea, has less force and constancy than that from the S.E. in the neighbourhood of the equator; owing, doubtless, to the form of the coasts which bound the ocean in this part. Nevertheless, in the neighbourhood of the Antilles, the trade wind generally blows strongly, varying from East to N.E.

Peculiarities of the Trade Winds.—It has been observed, that in the zone comprised between the equator and the parallels of 28° North and South latitude, in proportion as the sun approaches the equator, the winds blow, in the northern hemisphere almost from N.E., and in the southern hemisphere from S.E.

But if the sun is in the northern hemisphere, and at its greatest distance from the equator, the winds in that hemisphere have a tendency to blow more from the East, and more violent storms are then experienced than at

any other time. In the southern hemisphere, the trade wind then blows more from the South.

If, on the contrary, the sun is in the southern hemisphere, the same facts are produced in an inverted order ; thus, in this hemisphere the wind blows more from the East, while in the northern hemisphere it veers towards the North, and in this case they reach their nearest approach to the equator. And generally, in either zone, rain, sudden gusts of wind, and storms must be expected in those places where the sun is vertical.

During winter, the northern trade is sometimes met before reaching the latitude of Madeira. This fact is, however, only an exception to the general rule above laid down in alluding to the polar limit of this wind. At other times, the variable winds of the temperate zone extend as far as 20° North, without appearing subject to any general law ; and this, too, in all seasons of the year.

In the southern hemisphere similar facts appear. Thus, during the fine season, the southern limit of the trade winds from the S.E. is found to be about the parallel of the Cape of Good Hope ; while, from June to August, westerly winds are prevalent between that parallel and the tropic of Capricorn.

It has been also remarked, that near the polar limit of the trade winds, calms and light variable winds are often met with, producing rain, and this in a very extended zone, namely, that which separates the tropics from the parallels of 29° North and South.

Thus we see that the polar limits of the trade winds are very variable. In the southern hemisphere this limit

is sometimes near the tropic, but more frequently on the parallel of the Cape of Good Hope.

In this same zone it has been observed, with regard to the S.E. trade wind, that in latitudes South of 16° S., the wind has a greater tendency to blow from the N.E. than from the S.E., so as to blow rather from East to N.E. than from East to S.E. This variation is also pretty frequent. During a year's stay at St. Helena, Halley found that, in that island, the trade winds always blew from S.E. or nearly so; and that they more frequently veered from S.E. to East than from S.E. to South. During the East wind the weather was gloomy, and the return of fine weather depended on the wind from the S.E.

And, lastly, it may be stated that in approaching the coast of America the polar limits of the N.E. and S.E. trade winds extend some three or four degrees more towards the North in the northern hemisphere, and more to the South in the southern hemisphere than on the coast of Africa.

Deviations in the Trade Winds.—It happens sometimes in the region of the trade winds, that winds from opposite directions interrupt their usual course.* These

* Columbus, who was the first discoverer of the trade wind, in 1492, was the first to discover this irregularity; and it is remarkable that it was of service to him in quieting the fears of his crew, who, having observed the constancy of the wind from the eastward, believed that they never would be able to get back to Spain. This irregular wind broke the spell, and much to the satisfaction of Columbus, who was then beginning to feel the inconvenience of that mutinous spirit which, in a later part of the voyage, had nearly cost him his life.—*Landfall of Columbus*, by A. B. Becker, Captain R.N., published by Potter, 31, Poultry, London.

winds are never of long duration, and only arise from accidental causes.

In the neighbourhood of the islands situated in the zone of the trade wind, this wind is also interrupted. Thus, among the Cape Verd Islands, the N.E. trade wind is often lost; and in the zone comprised between the parallel of 10° latitude and the equator, and also from the meridian of Cape Verd to the most westerly meridian of this Archipelago, it is observed that there is, in reality, no settled wind, but only breezes of short duration.

In the vicinity of Trinidad, situated near the coast of Brazil, frequent changes have been observed in the trade wind from S.E. to South of these islands, coming more generally from the northward than from the southward, as well as sudden gusts from the West. In the two last-mentioned cases, the vicinity of the coasts of Africa and America doubtless occasions these disturbances.

Variable Winds of the Torrid Zone.—The South-eastern trade wind is separated on its equatorial border by a zone of calms and changeable winds, varying considerably in extent from North to South, the mean latitude of which is about 8° North. In this zone, calms, squalls, rain, and light breezes, blowing from all points of the horizon, are met with and chiefly from S.W. This zone, during summer, reaches further North of the equator, and is then found sometimes as far as the parallel of 14° and even 15° North latitude. In winter, on the contrary, it does not reach so far; and when the sun enters the tropic of Capricorn, it is not found beyond

3° N. latitude. It always keeps, however, North of the equator.

The following table is drawn up by Horsburgh, from observations made between 1791 and 1807, contributed by the journals of two hundred and fifty ships, which have crossed the zone of the variable winds of the equator, between 30° and 40° West longitude.

Month.	Sailing South the N.E. Trade Wind is lost in North lat. from	Returning North the N.E. Trade Wind is found in North lat. from	Mean.	Returning North the S.E. Trade Wind is lost in Latitude from	Sailing South the S.E. Trade Wind is found in North Lat. from	Mean.	Lat. of the Zone of Variable Winds of the Torrid Zone.
January.	5 to 10	3 to 6	5 45	0½ to 4 N.	2 to 4	2 45	3 0
February	5 .. 10	2 .. 7	6 0	2 S. ... 3	0½ .. 1	1 15	4 45
March ..	2½ .. 8	2 .. 7	5 0	1 .. 2	0½ .. 2½	1 19	3 45
April ...	4 .. 9	4 .. 8	5 45	2 .. 2½	0 .. 2½	1 15	4 30
May	5 .. 10	4½ .. 7	6 30	1 N. ... 4	0 .. 4	2 45	3 45
June ...	7 .. 13	7 .. 12	9 0	1 .. 5	0 .. 5	3 0	6 0
July ...	8½ .. 15	11 .. 14	12 0	1 .. 6	1 .. 5	3 30	8 30
August ..	11 .. 15	11 .. 14½	13 0	3 .. 5	1 .. 3	3 15	9 45
Septemb.	9 .. 14	11 .. 14	14 45	2 .. 4	1 .. 3	3 0	8 45
October.	7½ .. 13	8½ .. 14	10 0	2 .. 5	1 .. 5	3 0	7 0
Novemb.	6 .. 11	7 .. 10	8 0	3 .. 4	3 .. 5	3 45	4 15
Decemb.	5 .. 7	3 .. 6	5 30	1 .. 4	1 .. 4½	3 55	2 30

Favourable Time for crossing the Line.—The foregoing table shows the zone of the variable winds to be larger from June to December, and less from December to June,—an important condition in making a voyage, because, as a ship must go from one hemisphere to the other, and cross the equator, thus passing from the North or South, the most favourable months for crossing the zone of the variables will be those from December to June. According to the time of crossing the line the passage will be several weeks longer or shorter, as it is more or less interrupted by calms, squalls, or variable winds near the equator. And we must also expect it to

be longest from these causes during the months of June, July, August, and September.

It may also be seen that, in the northern hemisphere, the N.E. trade wind verges, according to the season, more or less towards the equator; but it rarely passes to the southward of it. On the contrary, the S.E. trade wind reaches it easily, and northward sometimes even so far as 5° North latitude, and that in the neighbourhood of the coast of America.

Union of the Trades.—It happens, however, that the N.E. and S.E. trade winds join each other generally somewhere about the meridian of 28° or 33° West longitude, where a ship may pass perhaps in a squall from one of these winds to the other without experiencing any calm. Sometimes even in the vicinity of the African coast, and generally from December to February, the N.E. winds nearly join those from S.E. The different directions of the trade winds from N.E. and S.E. occasion great uncertainty about the weather and the winds within their limits; an uncertainty which increases on approaching the zone of either. Besides this, it has been observed that near the equator the winds change more frequently from East to South than from East to North. We find, nevertheless, in the region of the variables of the equator, winds which blow from West to N.W., and from West to South, and generally from July to September.

The preceding considerations are of great importance in the general navigation of the Atlantic Ocean, and more particularly in that of the gulf of Guinea. We shall apply them hereafter when alluding to the routes

for crossing the Atlantic; for, according to that which may be adopted, the place of crossing the equator becomes important.

Extent of the Trade Winds.—The preceding observations on the winds of the first portion of the Atlantic Ocean refer to a considerable distance from the coast, which has some effect in modifying their direction as well as their force. It is observed that the North and South trade winds sometimes reach as far as the coasts of America, though they are not found regular till about 140 leagues from the African coast, and about 160 leagues from that part of it lying between Cape Palmas and Cape Verd. In this latitude, occasionally between June and September, and even till October, the variables are found even in 28° West longitude, blowing from West to N.W. and S.W., interrupted by calms, accompanied by rain and bad weather. The islands in this region also influence the trade wind in their vicinity, but much less sensibly than the continent. The higher these islands are, the more frequent is rain about them, at least so observation has shown; and it is generally found in the torrid zone that the wind which is constant at sea, becomes changeable near elevated and extensive coasts.

Seasons of the Torrid Zone.—In the Atlantic Ocean, within the torrid zone, the weather is very variable, according to the latitude and time of year. It is observed that the atmosphere is more unsettled during the spring and autumn months, generally at the time of the equinoxes, than during the summer and winter months.

In this zone, North of the equator, the rainy season begins when it is quite dry to the South of it, and *vice*

versa. And it lasts from April or May till September or October. The dry season begins in October or November and lasts till April or May. South of the equator the weather and seasons, in this zone, are contrary to those of the region North of the equator, and they change nearly in the same months.

As a general rule, it may be assumed that in both hemispheres the rainy or winter season commences at any place when the sun, moving from the equator, passes the zenith of that place; and the dry season begins when the sun, returning towards the equator, has repassed the zenith of the same place.

Clearly as this law indicates the seasons, it is nevertheless subject to many exceptions. Thus, the seasons do not begin and finish precisely at the period of these transits, but according to the time at which they take place. There is also always a period of doubtful uncertain weather, lasting a longer or shorter time, between each season, with variable winds, calms, and squalls, some of which have received the name of *tornadoes*.

In several places these squalls occur at the beginning and end of the rainy season; and limit the season of the great rains.

According to the foregoing law, it may be seen that the duration of the winter season at a place depends greatly on its latitude, and that it should be proportionably lengthened as it is nearer to the equator.

The hottest season within the torrid zone is that of winter, which is also the time of variables and calms. In the fine or dry season, on the contrary, the breezes are fresh and regular; this is generally the period when,

near the coasts, land and sea breezes prevail with regularity.

At places within the immediate vicinity of the equator, four seasons have been distinguished, two dry and two rainy; but, in reality, that part of the rainy season when rain is less abundant, and when rain squalls are separated by intervals of tolerable weather, has been considered one of the dry seasons.

Second Part of the Atlantic Ocean.—The second region of the Atlantic, as above said, is that comprised between the parallel of 30° South and the South pole; in which two zones are distinguished, the frigid and temperate. Let us now allude to the first.

Frigid Zone.—In the frigid zone, where but few navigators have penetrated, observations are necessarily few, and these relate only to one season, namely, the summer; that being the only time when it can be penetrated to the South. The celebrated Cook, Admiral Dumont D'Urville, and Sir James Ross, are the principal navigators who have penetrated into this dreary region of the Atlantic; Cook proved that between 60° and 70° S., the winds are generally moderate; Foster adds that they often blow from the East. Cook has also observed, that in those high latitudes the currents, though not strong, drift the ice towards the N.E., the North, and the N.W. D'Urville, after a stay of forty-nine days in that region, in which he could not penetrate beyond the latitude of $63^{\circ} 33'$ S., and was blocked up by the ice in $62^{\circ} 22'$ S. and 39° W., has left us the following observations, which appear in the voyage of the *Astrolabe* of 1837.

Variable winds from the East, between N.N.E.. S.S.E.. and South for twenty-seven days; westerly winds, varying from N.N.W. to S.S.W. twenty-two days, during the months of January, February, and the beginning of March. During this time, the sloops *Astrolabe* and *Zélée* experienced a breeze from the North, accompanied by fog and rain; with winds from S.S.W. and S.W. the weather was alternately fine and cloudy; the winds from this quarter were in general moderate, and sometimes fresh.

The winds from N.E. and E.N.E. sometimes brought fine weather, but the sky was more frequently cloudy and foggy; snow fell principally with the winds from E.S.E. to N.N.W. by the N.E.; with the same breezes there was fog. Lastly, the strongest were those from East, E.S.E. and S.S.E., which in general blew very fresh.

Sir James Ross crossed the parallel of 60° S. latitude on the 23rd of December, 1842. During his stay in the frigid zone, which lasted till the 1st of March, he made observations on the winds, of which the following is a summary:—

December, 1842.—Winds from West changing from N.W. to S.W., six days; winds from North, half a day; winds from South, a day and a half; winds from S.E., one day, moderate; those from South blowing very hard.

January, 1843.—Easterly winds changing from N.N.E. to S.E., twelve days; northerly winds, two days; southerly winds, three days and a half; westerly winds, varying from N.N.W. to S.S.W., thirteen days

and a half. In this month, two days of strong breezes from N.W., the other winds fresh or moderate.

February.—Easterly winds, changing from N.N.E. to S.S.E., eighteen days and a half; northerly winds, two days; South winds, three days; westerly winds, veering from N.W. to S.W., four days and a half. One day, a hard gale from the North; one day, a stiff breeze from the East; the rest fresh or moderate.

From the preceding observations it appears that during summer in the frigid zone of the second region of the Atlantic Ocean, the East and West winds are tolerably equal, but that the East winds rather prevail.

Temperate Zone.—In the temperate zone of this same region, westerly winds, extending as far as the tropic of Capricorn, and sometimes even to the latitude of 20° S., are predominant, varying from N.W. to S.W.; but the winds in this part of the Atlantic Ocean are changeable and irregular.

It has been remarked that in a zone comprised between the parallel of 28° and 35° S. latitude, the winds are extremely variable; but those which are most frequently met with are from N.E. to N.W.b.N. and from N.W. to S.W.b.W., principally during June, July, and August.*

The prevailing westerly winds, varying from N.W. to S.W., between the parallels of 30° and 50° S., appear to be produced by the meeting of the returning currents from West to East, occasioned by the trade winds, (and named here tropical winds,) with the polar currents proceeding from the poles towards the equator. The winds

* Dampier.

which result from these two currents of air ought to take almost a mean course, depending on the relative force of the two currents, and, consequently, this direction will be very variable, although it is generally from the West.

It has been observed that between 30° and 50° S. latitude, the winds blow periodically from S.W. to N.W.; thus, they vary from West to N.W. while the sun has South declination, and during the rest of the year they are in general from West to S.W., attended by bad weather.* In this zone the easterly winds are never of long duration. When the winds shift to the South a calm soon takes place; and it has been observed that between Cape Horn and the Cape of Good Hope, when the wind continues from the North for several days in succession, it brings dark rainy weather; if these winds shift to South of West, the weather clears up and becomes fine.†

Third Region of the Atlantic.—The third region of the Atlantic is comprised between the parallel of 30° N. latitude and the North pole, and is here divided, like the preceding one, into two zones—the frigid and temperate.

Frigid Zone.—In the frigid zone, comprised between 60° N. latitude and the pole, and between Europe and America, and which includes Spitzbergen and Iceland, the winds are variable. The snow-clad lands in this zone, and the ice which prevails there, exercise a most powerful influence on the winds, varying them according to the seasons. The different navigators who have tra-

* Nicholson.

† D'Apres di Mannevillette.

versed this zone, in what is called the northern frozen ocean, have not observed any law in the winds,* principally during summer.† However, several navigators agree in acknowledging the northerly winds as regular and prevalent.

Every wind in this zone is accompanied by a low temperature and snow, excepting in July and August, and a part of June. At this period, with southerly winds, the weather is tolerably fine, although attended by snow and rain. The same winds bring fog during those months. The coldest winds are those from North and N.E.; during June and July, winds from S.S.W. are frequently met with, sometimes blowing with much violence. In April and May, South winds are attended by snow; in the rest of the year there are thick fogs, and very bad weather.

Spitzbergen.—At Spitzbergen it is said that during the first months of the year southerly winds prevail, and during the other months those from the North; but the S.E. and N.E. winds are those which bring most snow. Annexed are the observations of Sir Edward Parry, during the months of May, June, July, and August, 1827, on the winds of those regions comprised between 70° and $82^{\circ} 40'$ N. latitude, as given in the narrative of his voyage towards the North Pole in the *Hecla*.

North	7½ days.	W.S.W.	1 days.
N.N.W.	5½ „	S.W.	9½ „
N.W.	9 „	S.S.W.	1 „
W.N.W.	2 „	South	4 „
West	13 „	S.S.E.	2 „

* Phipps.

† Standidge.

S.E.	12	days	N.E.	9½	days.
E.S.E.	½	"	N.N.E.	11	"
East.	17½	"	Calms	13½	"
E.N.E.			Variables..	4½	"

Nova Zembla.—At Nova Zembla, from September to May northerly winds prevail almost without interruption; and from May till August those from West.

Temperate Zone.—In the temperate zone, comprised between the latitudes 30° and 60° N., the prevailing winds are, like those of the corresponding zone of the other hemisphere, from the West, varying from N.W. to S.W. The prevailing West winds are doubtless produced by the same causes as those already stated in alluding to the corresponding zone of the southern hemisphere. They are produced by those currents of air, named "tropical winds," blowing from West to East, and the polar currents directed from North to South. Their direction, therefore, depends on the relative intensity of these currents, and might be a middle one.

There is an important fact which shows the prevalence of S.W. winds in the temperate zone of the northern hemisphere, consisting in the difference of time occupied by the passage from the North of Europe to North America and that of the return passage home from North America to Europe. From Liverpool to New York the voyage is at least forty days; while from New York to Liverpool it is only about twenty-three.

The mean direction from whence is the prevailing wind of this zone, has been determined by Kramtz from numerous observations as follows:—France S. 88° W.; England S. 66° W.; Germany S. 76° W.; Denmark

S. 62° W.; Sweden S. 50° W.; Russia N. 87° W.; North America S. 86° W.: showing that Russia is the only country where the wind has a little North tendency in its source.

In the Atlantic Ocean the direction of the prevailing wind is generally from S. 45° W. to S. 70° W.

When the sun is in the northern hemisphere the prevailing westerly winds are S.W. and W.S.W.; if, on the contrary, the sun is in the southern hemisphere, they are from W.N.W. and N.W. This last period is that of gales and bad weather between North America and Europe.

Having described the winds met with *at sea* in the Atlantic Ocean, it remains for us now, in order to complete our view of the winds of this ocean, to allude to those which are experienced on its coasts. We shall commence with the coast of Africa, offering first some general remarks as to that coast.

Land and Sea Breezes.—The land and sea breezes blow on certain parts of it with great regularity, particularly on those of the intertropical continents, and the islands situated in the torrid zone, so much so that they might be reckoned in the periodical winds. In general the sea breeze blows during the day, and the land breeze commencing towards evening lasts part of the night, blowing in the opposite direction; it commonly ceases shortly after sunrise, and rarely lasts beyond nine or ten o'clock in the morning. Philosophers attribute these breezes to the difference of temperature between the sea and the land.

It is observed that in the neighbourhood of the African

coast of Morocco, the sea breeze comes most frequently from N.W.; on the coast of Guinea from South to S.W., and on that of Loango and Congo from S.W. to West. These breezes generally blow alternately with those from the land. They are generally found as stated near the coast, but they sometimes prevail far from it, gradually losing their force, until they are opposed and overcome by the general winds. The parts where these changes occur, are almost always subject to storms, accompanied by rain or calm.

The following general view is given by philosophers of the alternate land and sea breezes. In the morning, the temperature of the land and sea being nearly alike, the air is at rest. But when the sun rises above the horizon and the earth begins to be more heated than the water, the sea breeze begins to be felt; gentle at first, but gradually gaining force, till it attains its height with the greatest heat of the day. It then diminishes gradually with the decrease of temperature till night; when an interval of calm takes place. Again, during the night, when the land is colder than the sea, the land breeze rises, and attains its greatest strength at the time of the highest temperature of the night. It continues until day, still diminishing, and sometimes even until eight or nine o'clock in the morning, according to the latitudes. A knowledge of these phenomena is highly useful, and is particularly advantageous in local navigation, when it may be turned to good account in shortening passages.

Solar Breezes.—There are yet, on some parts of the western coast of Africa, certain winds, which may be

called solar, their changes appearing to be regulated by the influence of the sun. We find them principally in the North, on the coast of Senegambia; and also in that extending from Cape Lopez to Cape Negro, to the South of the equator.

On the former coast these winds vary from N.E. to N.W.; on the second, from S.E. and South to S.W. and even to W.S.W. The course of these winds, which blow strong on the coast of Senegambia, principally from November to April; and on the other from October till March, and even April, is as follows:—The breeze at sea lasts through the day, strengthening in the afternoon, then weakening towards the evening; during the night, it changes, and blows more along the land.

In navigating these two coasts, a ship should regulate her sailing so as to be near the land when the night breeze springs up, and out at sea when that of the day begins. These winds, the variations of which occasion the alternate land and sea breezes, do not, however, blow directly off the shore. They are sometimes very strong, though at a short distance from the coast; and in order to profit by them it is necessary to make short boards of twelve, fifteen, or thirty miles at farthest from it.

The Harmattan.—The harmattan is a wind peculiar to the western coast of Africa; it blows from East, changing to E.N.E. on the North coast, from the parallel of Madeira to that of the River Gabon. It is sometimes very strong on the coasts of Senegal and Senegambia, but often light on the coast of Guinea. It is a cold dry wind, generally lasting for a series of three, six, or nine days, principally between the end of November and

February or March. It reaches, however, but a short distance from the coast, sometimes commencing at sunrise and ending in the afternoon. This wind is often accompanied by fog, and sometimes loaded with a fine reddish dust, so thickly that nothing can be distinguished, particularly near the coast, at a trifling distance.

At Senegal this is an extraordinary dry wind, and produces the most singular effects. It is said to be generally healthy, though certainly very disagreeable and inconvenient. The greatest advantage derived from it, nevertheless, is the production of gum. It suddenly arrests the circulation of sap in trees that is flowing rapidly at the season when the winter rains are just ended, and causes it to exude from the wood, thus forming gum, constituting the principal commercial greatness of Senegal.

Tornadoes.—Tornadoes are violent squalls of short duration, but are very frequent on the West coast of Northern Africa. In the South they are seldom felt, and are always slight. The name is derived from the sudden changing or veering of the wind while they last. Their approach is made known long beforehand by clouds of a dull yellow colour, which by night are very black. They originate to the North and N.E., and generally move against the prevailing wind. Tornadoes are generally distinguished by electric phenomena, and they gradually overcome the prevailing wind.

Every precaution becomes necessary to meet a tornado. Dark heavy clouds gradually spread on the horizon, and lifting slowly, leaving an extensive arch clear and distinct, are furrowed every now and then by light-

ning; the clearer the arch is defined the more violent will be the approaching storm.

A few moments of calm then ensue, and the N.E. wind is suddenly felt coming violently and rapidly with the storm, which breaks forth in all its fury when the arch attains the height of thirty or forty degrees above the horizon.

From N.E. the wind veers rapidly to East or S.E. blowing with the same force. The storm afterwards ceases, with rain, and when the wind slackens in force it veers to the South, and when it becomes still less to S.W. A calm frequently succeeds a tornado; and it is found that when the wind precedes the rain, the storm is more violent.

Vessels to meet these passing squalls, which never last more than an hour and a half, should shorten all sail, and furl, if possible. We never know what the extent of these violent commotions of the atmosphere may be, which sometimes have the force of hurricanes of short duration, in which the wind changes so suddenly that a sail might be split and inevitably lost.

The S.W. winds of the West coast of Africa are often disturbed at certain periods, (especially in the winter,) for we find in the Mediterranean, and on the coast of Portugal, intense polar currents, which, increasing the rapidity of the trade wind from North, forces it abruptly towards the equator. The meeting of these winds and those from S.W. prevailing at this period, contributes, perhaps, to produce tornadoes. They are very frequent in the northern hemisphere, and also very violent. South of the equator, on the contrary, as already ob-

served, these disturbances of the atmosphere are rarely felt.

On the coast of Gaboon, and in the gulf of Biafra, tornadoes blowing from N.W. to West and S.W. sometimes though very rarely occur. In the northern hemisphere they principally take place at the commencement of the winter season, and consequently the time of their appearance varies according to the place. Thus, they are found at Cape Palmas a month earlier than at Sierra Leone; while at Goree and St. Louis, to the northward, they are a month and a half after they have prevailed at Sierra Leone. In several localities they take place exactly at the end of the winter season, principally from the archipelago of the Bissagos to Cape Palmas and the coast of Guinea. In the gulf of Guinea they come chiefly in the months of March, April, and May, and they again occur in some localities during November and December.

South of the equator the tornadoes blow chiefly from S.E., and take place from March to June, and from September to October. They diminish in force in proportion as they are found to the South; and in the latitude of the Kongo, it is not unusual for storms, without much wind, to form in the East, and passing South, to terminate in the S.W. They are much like the storms which are encountered in the northern hemisphere. These are somewhat similar to tornadoes in the changes of the wind, but not in force.

On the coasts of Angola and Benguela, towards the evenings of November and December, storms of this description are found, but very rarely accompanied by

much wind. On the contrary, the clouds heap together, and the wind falls gradually to a calm. These clouds generally become scattered at ten or eleven o'clock at night, and at the same time a feeble land breeze rises, which usually lasts during the remainder of it.

Cape of Good Hope.—About two hundred leagues West of the Cape of Good Hope, S.E. winds prevail from October to March, and even April. In the same latitude, from May to August, at a hundred leagues to the West of the Cape, winds changing mostly from N.W. to S.W., are found, bringing a high sea with dirty weather. The same winds extend two hundred leagues to the East of the Cape of Good Hope, and the weather becomes worse as it is approached, during this season, from East to West.

N.W. winds here bring fog, rain, and haze; but the weather is fine and cold when it blows from S.W. During April and May these winds are found equally to the East and West of the Cape, but only as sudden gusts. These gusts are preceded by black clouds gathering in the West. The wind then begins blowing violently from W.N.W. to West, and then changes rapidly to S.W.; it then passes to the South, afterwards moderates, and soon after a calm ensues.

Doubling the Cape of Good Hope from Eastward.—When the season is advanced, D'Apres de Mannevillette advises a ship that would round the Cape from the East, not to go further than forty miles from land, and not nearer to it than eighteen miles, in order to preserve a latitude where the winds are less violent and the sea not so high as to the southward.

These stormy winds are very frequent during the winter. They are accompanied by so much rain, that sometimes two successive fine days can scarcely be found. According to several mariners, this bad weather is felt as far East as Madagascar.

On the parallel of 36° S. latitude, at 200 or 250 leagues from the Cape of Good Hope, to the East and West of the Cape, the N.W. winds, which are so violent near it, become moderate, and frequently vary to S.S.W. Generally between the parallels of 33° and 36° S. latitude, the West winds appear to prevail.

Doubling the Cape from Westward.—Consequently, when doubling the Cape from the West, it will be best to keep well off the land on the parallel of lat. 35° or 36° S., and to enter the Indian Ocean nearly on that of 36° . In adopting this course, a vessel would also profit by the *cross* current of the Atlantic Ocean setting eastward.

Winds at the Cape of Good Hope.—At the Cape of Good Hope and in Table Bay the months of September, October, and November form the spring; those of December, January, and February the summer; March, April, and May are the autumn; and June, July, and August the winter months. The following table, constructed from observations made in the course of many years at Cape Town, shows the prevalent winds during the year and in each month.

Months.	Winds.	Remarks.
January	S.E.	Dry, hot, occasional rain, with wind from N.W. Temperature variable, heavy rain occasionally with N.W. winds.
February	S.E.	
March	S.E.	Heavy gusts from N.W.; thunder; light rain and mist.
April	S.E. & N.W.	Heavy gusts; temperature variable, and mist.
May	N.W.	Fine at the beginning of the month; thunder and tempestuous at the end.
June	N.W.	Heavy gusts sometimes from S.E. or N.E.; rain, thunder, and stormy.
July	N. & N.N.W.	Frequent gusts of wind; cold, mist, snow, rain, hail.
August	N.W.	Ditto.
September	S.E.	Weather changeable and mild.
October	N.W.	Heavy rain; thunder and lightning.
November	N.W. & S.E.	Hot dry weather; moderate breezes.
December	S.E.	When the wind blows from N.W. the breezes are light,—the weather hot and dry.

During winter, ships cannot anchor in Table Bay; and to refit at this season they anchor in False Bay. The approach of winter in the neighbourhood of the Cape of Good Hope is indicated by the prevailing S.E. winds being interrupted occasionally, and also lessening in force.

Trade Winds of the West Coast of Africa between the Cape of Good Hope and Cape Palmas.—If a line be drawn from the Cape of Good Hope to Cape Palmas, it will nearly be that of separation between the S.E. trade winds and those prevailing winds, varying from S.S.E. to S.S.W. and S.W., which blow during the whole year in that part of the ocean between the above line and the West coast of Africa. The distance from the coast at which these winds prevail is variable, as the limit itself is, and they are found much stronger on approaching the Cape. It has also been remarked that on this part of the African coast the wind frequently takes a direction making an angle of about two points with the line of the coast.

At eighty or a hundred leagues from the North coast of Guinea, and on the line of separation above-mentioned, the trade wind is generally found; which at this distance begins also to incline towards the coast, and in proportion as this distance is lessened draws to South and S.S.W. and even to S.W. On this limit of the trade wind calms, storms, and variable winds are generally found.

Hottentot Coast.—During nearly the whole year on the Hottentot coast, and that of Cumbasea, strong breezes from South prevail, changing from S.S.E. to S.S.W., sometimes in heavy gusts of wind. In proportion as the coast is left, these breezes diminish in strength, veering to South and S.S.E. in order to join the S.E. trade.

Coast of Benguela and Angola.—On the coast of Benguela and Angola the weather is generally fine all the year, except during the months of March and April. In November, December, January, and February, S.S.W. winds blow fresh; also S.W. and W.S.W., and now and then those from W.N.W.; so that in these months navigation is easy on this coast. In November and December there is sometimes a little small rain, especially in the mornings, with the wind from S.E. or at least South. Directly it draws to S.W. the weather clears off and the sky suddenly lightens up. Sometimes, again, there are appearances of stormy weather and lightning, particularly in the evenings; but, as already noticed, these storms bring but little wind, and this frequently falls away until it gradually becomes calm. These appearances seldom, as already stated, last longer

than ten or eleven o'clock at night; and then a gentle land breeze rises, which generally lasts till morning. March and April are the two worst months of the year, on account of their stormy character. However, as soon as the wind veers to S.W. the sky clears and the weather becomes fine. The land breeze then comes on from S.E., and sometimes from N.E.; but these gusts are quite unlike the tornadoes North of the equator.

From May to October, during the "fine season," the sky is often overcast, especially in the morning, and the sea breeze is then seldom strong; while, on the contrary, it rarely fails when the sky becomes clear, and is still fresher when it clears quickly. In May and June the calms are less. The sea breeze begins late, and the land wind is fresh till after sunrise. In July, August, September, and October, S.W. winds are fresh and well established. They are found near the coast at ten or eleven o'clock in the morning; falling towards sunset, and rarely last later than seven or eight o'clock in the evening. During October they sometimes last till midnight, and are followed by the land breeze till eight or nine o'clock in the morning. In the interval between these breezes there is sometimes a calm.

Coast of Congo.—On the coast of Congo the breezes are generally moderate, and from September to March between South and West. From March to October the prevailing winds are from S.S.E., and are sometimes strong from between East and North. Strong sea breezes are sometimes found between North and West, generally from April to August. During this season

there are very heavy rains. In the fine season, from September to March, the land and sea breezes succeed each other regularly. But they are not so regular during the rainy season, which lasts only three months, from November till February.

Rio Congo.—In the River Congo the seasons and winds are nearly the same as on the coast to the South of this river;—observing that the further South, the later are the seasons. Thus, in the River Congo the rainy season is from October to January.

Coast of Loango.—On the coast of Loango, from September to March, the prevailing winds are from South to West. In December and January strong winds prevail from West and S.W. From March to October the wind is generally from S.S.E., changing to South and S.S.W.

The alternate land and sea breezes are very regular on this coast, except during the rainy season—from September to December. Tornadoes take place in March, April, May, and often in September and October; sometimes also in January and February. These tornadoes, generally less violent than those North of the equator, are, however, sufficiently severe to oblige ships to reduce all sail.

Cape Lopez.—Off Cape Lopez, from June to October, the wind is generally from South, moderate, as well as that from S.S.W., which wind prevails during the other months.

At the end of November storms with heavy rains occur. The tornadoes are most severe in March and April. They also occur in November, December, and January;

as well as storms, which differ from tornadoes only by the wind being less violent.

Gulf of Biafra.—On the eastern shore of the Gulf of Biafra, two seasons only are generally known; that of tornadoes and bad weather lasting from March till the middle of September. July and August are comparatively the dry months, in which the S.S.W. breezes are fresh; they veer to the S.S.E. sometimes and blow fresh, commencing North of the equator as far as lat. 2° or 3° . The rainy season begins in September and lasts till March. This is the time of calms and light breezes from South to W.S.W.

The islands of the Gulf of Biafra—Princes Island, St. Thomas, and Anno Bom—have the same winds as the adjacent coast. The alternate land and sea breezes are more regular and fresh near them, and cease about the time of the rainy season. The former never reach far from the coast either of the continent or the islands.

North Coast of Biafra, Coast of Benin and St. Paul to Cape Palmas.—On the North coast of the Gulf of Biafra and Benin, and on the shore of the Gulf of Guinea, a moderate trade wind comes from S.W. to West, and prevails, with more or less regularity, according to the season, during the whole year. The harmattan on this coast, blows in November, December, and January, from the East, but never strong.

From October to February, the period called the fine season, alternate land and sea breezes are found near the coast. The former never extend further than four leagues off shore and are always weak. The tornadoes on this coast occur from March to May. In April and

May, in the Gulf of Benin and Biafra, one may be looked for every forty-eight hours, and frequently two in one day, and extremely violent. On the Ivory and Gold coasts they last till June. The period of heavy rains in the Gulf of Benin and Biafra is from August to September; but on the Ivory and Gold coasts it is from May to June.

The fogs, (commonly known as the "smokes,") which are very thick on this part of the coast of Africa, take place in July, August, and September on the Ivory and Gold coasts, also from December to February. In the Gulfs of Benin and Biafra, they are particularly found from October to February. These fogs generally commence at three o'clock in the morning, and clear away towards ten or eleven a.m.

Island of Fernando Po.—In the island of Fernando Po the climate is the same as that of the Gulf of Biafra adjacent to it. The harmattan blows there from December to February,—the most healthy season of the year. On the coasts above-mentioned and at Fernando Po, in the rainy season, the alternate land and sea breezes either fail or blow irregularly.

At the island of St. Helena, S.E. winds blow during nearly the whole year. They are only interrupted for a few days during this interval by light westerly winds, principally in June, July, and November; in which last month there are generally six days of westerly wind.

Ascension Island.—At the island of Ascension the winds are the same as at St. Helena, continuing moderate during the whole year.

Cape Palmas and the Coast of Liberia.—In the lat-

itude of Cape Palmas, and to the South of this cape, the trade wind is W.S.W. To the North of the cape, it blows from S.W. and S.S.W., and during the fine season (from December to March) it varies from W.S.W. to W.N.W. The rainy season here lasts from May to October. The same winds prevail on the coast of Liberia.

The great rains fall principally in July and August. In April and May there are violent tornadoes, but they cease during the heavy rains and recommence in October and November. During the fine season the alternate land and sea breezes are very regular; the former are found twelve miles from the coast. The land breeze varies from N.N.W. to N.N.E., and lasts from noon to midnight. The sea breeze varies from W.S.W. to W.N.W., changing very gradually, and at the middle of the season changes to North. It changes to South at the end and beginning of the season, and shifts, according to circumstances, eastward or westward. There is often an interval of calm between the land and sea breezes. The harmattan blows in December, but only occasionally and then with no strength. It is neither cold nor disagreeable, as on the coast to the North of Cape St. Anne.

It has been observed that on the coast of Liberia, during the rainy season, the weather is not so bad on shore as it is thirty or forty miles out at sea. Thus, in this season, at that distance, calms, rains, and baffing winds are found, and even storms and tornadoes; in both of which the wind is mostly from East, but not strong.

Coast of Sierra Leone.—On the coast of Sierra

Leone, during the fine season—from November to April, the prevailing wind is from N.N.W. to N.W. In the winter season it is S.W., changing to W.S.W. and W.N.W., blowing sometimes strong from West. The harmattan is sometimes severe in November and December; then, during the following months, it becomes moderate. It is not permanent, and blows only at intervals, varying between E.S.E. and N.E.

Tornadoes occur in May. During the great rains from June to September, they partly cease, and return in September, October, and November. In the winter season the sea breeze is generally light, changing from S.W. to W.S.W. and interrupted by N.W. winds.

During the fine season, from the Isles de Los to Cape St. Anne, alternate land and sea breezes prevail, from W.S.W. and E.N.E., *passing by the North*. The sea breeze lasts from ten or eleven o'clock in the morning till midnight. The change in the land and sea breezes takes place round by the North, after an interval of calm or only a successive change of wind from W.N.W. and N.W. to North and N.E.

In taking a general view of this coast, the prevailing winds are found to be from the westward; from W.N.W. during the fine season; and from W.S.W. and S.W. during the rainy season, or from May to November.

The following table has been compiled from numerous observations at Sierra Leone during the year.

Months.	Winds.	Remarks.
January	N.W.	Sea breeze in the afternoon; harmattan in the morning.
February	N.W.	Storms with rain.
March	N.W.	Tornadoes.
April	N.W. to S.W.	Ditto.
May	S.E. to S.W.	No tornadoes; partial storms.
June	S.E. to S.W.	Rain with S.E. winds; intense heat.
July	S.E. & S.W.	Ditto.
August	S.E. & S.W.	Ditto.
September	E. to S.W.	Tornadoes.
October	W.N.W. & S.W.	Cloudy; oppressive heat.
November	N.E. & W.N.W.	Ditto.
December	N.E. & N.W.	Ditto; thunder and lightning towards evening.

Weather of 1834 at Sierra Leone. The numbers in the columns express days.

Months.	Fine.	Cloud.	MistF.	Rain.	Months.	Fine.	Cloud.	MistF.	Rain.
January.	31				July	5		3	23
February.	28				August	8			29
March	30	1			September	10			20
April	26		4		October	26		5	6
May	14		5	12	November	31		4	5
June	14		8	13	December	23		4	4

Coast and Archipelago of Bissagos.—On the coast and archipelago of Bissagos, the West winds, changing from W.N.W. to S.W., prevail during nine months of the year. They blow in the winter season (from May to October) without interruption from W.N.W. to S.W.b.W., and sometimes with violence during July and August. Tornadoes take place principally in June, and also in September and October.

The harmattan blows (and sometimes with much strength) in November, December, January, and the beginning of February. In the fine season, along the coast and in the archipelago, alternate land and sea breezes are found. Those from the land blow from N.E.

to E.N.E. and E.S.E. till eight or nine in the morning, then till eleven or twelve o'clock there is calm, which is succeeded by the sea breeze, rising from W.N.W. or W.S.W. It lasts till past sunset, and is succeeded by the land breeze, which rises towards midnight.

Coast of Senegambia.—On the coast of Senegambia, during the fine season (from September or October until May) the prevailing winds are N.E., changing to N.W. by the North. The solar breezes are settled and regular on this coast; they are mostly moderate, though occasionally strong.

The harmattan blows with violence in November, December, and January; it becomes moderate in February and March. It continues sometimes for six or nine successive days, and at other times blows only in the morning.

In the winter season violent tornadoes occur in May and June.

The great rains commence in July and last during August; and at the end of this month there is sometimes a return of tornadoes. The prevailing winds during this season are from S.W., light, and interrupted by calms; they sometimes blow strong from West. On this coast, while the fine season lasts, land and sea breezes blow alternately; the solar breezes are more regular, varying from N.N.E. to North in the morning, and from North to N.N.W. and N.W. in the evening. During the night the wind is light from East and E.N.E.

Cape Verd Islands.—Among the Cape Verd Islands from November to May, the trade wind blows from N.E. to North or N.N.W. In the three first months of the

year it is generally more from the North than on the coast of Senegal. In June it is from East, and weaker. The rains begin about the end of this month. From July to October there are tornadoes and rain. During the rainy season, from June to October, South winds are found, changing to S.E. and S.W., stormy, sometimes with fog. After the 15th of August it is not prudent to remain in the bays of these islands, which are exposed to S.W. and S.E. winds.

Coast of Senegal.—On the coast of Senegal, and between Cape Blanco and Cape Verd, winds from East to N.E. prevail from October to May, including eight months of the year. The winter season lasts from June till October, when tornadoes, and light winds from S.W. to W.S.W. occur.

At some distance from the coast, in the fine season, North winds are often found blowing towards the shore, while, at the same time, further out at sea, the wind is from N.E. This coast is equally subject to the solar breezes, varying from N.E. to N.N.W. The breezes from N.N.W. prevail in the afternoon, those more easterly in the night and towards morning.

Canary Isles.—In the archipelago of the Canaries, situated near the limit of the N.E. trade winds, the winds blow from N.N.W. to N.N.E. by the North, during nearly the whole year, and particularly from April to October. From this last month also till February their direction is nearly the same. These winds are however interrupted by violent S.E. and S.W. winds, which last sometimes seven or eight consecutive days in December to January, accompanied by much rain.

The roadsteads of the Canaries are dangerous during these winds, and they ought not to be visited at such periods. In the Grand Canary, the bay of Palmas is the only one which may be frequented without danger in December and January, because a ship can get under sail there with any wind.

Madeira.—At Madeira the N.E. trade wind becomes settled about the middle of April, and continues so till the end of September. In October the periodical rains may be expected, which commonly last for fifteen days. They frequently begin with a strong S.E. wind, which changes to S.W., and continue to veer round to N.W., when the weather clears up. The roadstead of Funchal is very dangerous with these winds.

In November and December fine weather is found there, with the N.E. wind, which is yet irregular. January and February are the two months in which strong S.W. and South winds occur; but N.E. winds often blow during these months. In March the prevalent winds are generally from N.W., and sometimes very strong. During this month a great deal of snow falls on the mountains of Madeira.

In April the weather is often bad until the middle of the month, and it sometimes blows very hard; but it is mostly fine in the beginning of this month. In May, June, and July, the nights are clear and the days cloudy. Regular land and sea breezes then prevail.

During August and part of September the harmattan, called by the inhabitants the East wind, sets in; it blows sometimes from the East, during six or nine days following, as it does on the coast of Morocco opposite Madeira.

There is not a gale of wind in this island from the middle of April until the end of September: but they may be expected in November and December, commencing either to the eastward or westward of South, gradually drawing to West, and terminating at N.W.

Coast of Morocco.—On the coast of Morocco the prevailing winds during the fine season are fresh from N.E. to N.W. by the North. In winter S.W. and S.S.W. winds prevail, veering sometimes to W.S.W. and blowing hard. The wind shifts from S.E. to S.W. and W.S.W. rapidly in the winter, bringing bad weather; but when it is W.N.W. or N.W. the weather clears up.

Coast of Portugal.—On the coast of Portugal, and in general from Cape Finisterre to Cape St. Vincent, during ten months of the year northerly winds prevail, varying from N.E. to N.N.W. They blow fresh with fine weather, especially during summer. If there should be a gale during winter, it comes most frequently from South or S.W., sometimes from W.S.W., and blows very hard.

From Cape St. Vincent to the Canary Isles, the prevailing winds are from N.E. to N.W.

Bay of Biscay.—In the bay of Biscay the wind is most variable; but it has been observed that in the winter months it varies from S.W. to N.W. by the West, the last being the most frequent. From May to September, sometimes also in December and January, winds from E.N.E., East, and E.S.E. are found. During the two last-mentioned months, these winds are fresh and lasting; those from N.E. freshening up with rain, and

if there is a gale of wind it will come from East or S.E., and may be expected to be severe.

On the coasts of Brittany S.W. winds prevail; weak in summer, but violent in winter, and changing from West to N.W., from whence heavy storms and gales of wind may be expected.

At the entrance of the Channel, and on the West coast of France, the prevailing winds are generally from S.W., varying to West, W.N.W., and N.W. They last very long, blowing for seven or eight months, and freshen into violent gales, especially in winter. The wind from W.S.W. and S.W. is generally accompanied by rain or fog, while from N.W. it is stormy, but attended frequently with a clear sky. Should the N.W. wind be moderate, it is generally attended with fine weather, interrupted, however, in winter, by storms of considerable violence, attended with hail and thunder. On the West coast of France these are commonly called "sea storms." These winds may be relied on more than any others. They sometimes originate in northern America, and traverse the whole Atlantic Ocean.

In summer S.W. winds prevail, alternately moderate and fresh with foul weather. However, in this season, the sky is generally clear with a S.W. wind,

In this season, if the wind is S.W. and the weather fine, if it veers to N.W. it generally strengthens, but the weather will still continue fine.

Strong S. W. and N. W. Breezes in the Bay of Biscay.—In the English Channel or Bay of Biscay, when the wind comes in squalls from S.W., whether in summer or winter, if it be attended by rain, increasing

in quantity, and the squalls become heavier and more frequent, with a slight tendency to vary, a change of wind may be expected. Generally the change is from S.W. to West, rapidly, and sometimes to N.W. in a squall, and blowing harder than before. This state of weather may become of serious consequence to ships working to windward and on the port tack, and even to those running free or with the wind abaft, if unprepared and sail be not reduced in time.

Sometimes the change from S.W. to N.W. is preceded by a short calm, which must never be trusted. It has also been observed in the bay of Biscay that when a breeze springs up from a point opposite to the sun, it does not last, and indicates merely a slight derangement of the atmosphere.

Winds from North and South.—Winds from North and South are not very frequent; they prevail now and then, but not to a great extent nor for a long interval, although they sometimes freshen up into strong breezes, and even gales. Those from South will draw to S.E. or S.W.; and those from North will become N.E. or N.W.

Entrance of the Channel.—At the entrance of the Channel, although the wind is very changeable, it is found that westerly winds are most prevalent in September, October, and November; and easterly winds in December, January, and February.

British Isles.—On the shores of the British Isles, the prevailing winds are nearly the same as those in the bay of Biscay. It is, however, observed that in Scotland North winds are very frequent, and that East winds blow

principally from March to June. In England and Ireland South and S.W. winds prevail; and it is observed that on the coast of Cornwall westerly winds blow during nearly nine months of the year.

Coast of Holland.—On the coast of Holland westerly winds prevail, attended by rain and fog. Winds from S.E., South, and N.W. seldom blow, but from S.W. they do frequently; and easterly winds, which occur in every month of the year, are found principally in the four winter months, producing dry cold weather.

Coast of Norway.—On the western coast of Norway, the prevailing winds are from S.W. to South, frequently attended by rain.

Greenland.—Greenland cannot boast a periodic wind. From May to July the weather is fine, the wind changeable, but most frequently very strong from S.S.W. Even until September the winds are variable, but rain is by no means frequent. Storms seldom occur, and when they do are of short duration. The most violent squalls come from South. The coldest winds are from N.E., and this may form the sum total of our remarks on Greenland.

Arctic Region in North America.—In the following table we have resumed the observations on winds collected by Captain Parry in his voyage to the arctic regions to discover a passage from the Atlantic to the Pacific Ocean. These observations are doubly interesting since they are continued without interruption from July, 1819, to September, 1820; consequently showing the prevailing winds of these frozen regions during more than a year. This table is only a summary of those

Month.	N.N.W.	N.W.	W.N.W.	West.	W.S.W.	S.W.	S.S.W.	South.	S.S.E.	S.E.	E.S.E.	East.	R.N.E.	N.E.	N.N.E.	Calm.	Variable.	General Remarks.
1819.																		E. and S., fresh, with rain; the other breezes light; much mist and fog; snow with N. wind.
July.	3	5½	3	4½	..	2½	3	1	2½	3	..	2	..	..	1½	2½	..	Strong E. winds and fog; N., moderate, cloudy; S.W., rain; N.N.W., fresh, cloudy, misty.
Aug.	4	..	5	1½	..	6	1½	2	1½	1½	..	4	..	2½	1½	1	1½	Strong W. in gusts; N.N.E., fresh, misty, with strong N. wind; other breezes moderate.
Sept.	7	4	4	2½	..	5½	..	..	..	..	..	..	..	1½	4½	..	..	Strong N., weather clear, fine; N.W., fresh, cloudy; W., fr., snow, fog; S.W., st., misty; E., st., snow.
Oct.	10½	7½	1	5½	..	3	1	..	1	..	..	1	..	1	..	..	1	N., moderate, fine, snow, hurricanes; S.W., fine; other breezes light or moderate.
Nov.	16	6	1	1½	..	1½	..	..	..	..	..	..	..	..	..	..	1	E., fresh, weather cloudy; mist and fog with S.
Dec.	5½	3	5	3	1	½	..	2½	1	1½	1	2½	5	..	..	..	1	S.S.E., st., fine weather; N. and N.N.W., st. or fr., fine, much fog during this month.
1820.																		N.N.W., strong; N., fresh, much fog.
Jan.	11½	7½	½	4½	..	..	..	..	1	1	..	1	..	..	1	1	1	N., fr., weather clear, some snow; S., clear; W. fr.
Feb.	9	9	2½	3	..	..	..	1	..	1	..	1	..	..	..	2	2	N.N.W., fr.; N., light, snow, fine; E., fr., snow.
March.	17½	4	3	..	..	..	..	4	1	1	2	2½	..	..	1½	1	5	N. and N.N.W., strong, alternate clear and cloudy weather; squalls from N.W.
April.	9	4	3	..	..	..	..	..	..	..	1	1	..	1	..	3	1	N., st., fine, cloudy, rain, fog, snow for two days.
May.	11	3	5	..	..	..	..	4	..	1	1	1	..	..	..	..	5	N., st., fine, cloudy, rain, fog, snow for two days.
June.	7	2½	2	4	..	..	2½	2	1	2½	1	1½	..	..	..	..	5	N., st., fine, cloudy, rain, fog, snow for two days.
Total	111½	56	32	32	1	19	2½	14½	8½	12½	8½	19½	..	6	10	11	21	N., fr., cloudy; S., fr., rain; S.S.W., st., freq. fog.
July.	9	1	3	1½	..	1½	1	4	2	1	..	1	..	..	3	..	3	W.N.W., N.N.W., E.S.E., fr., snow, fog, often cldy.
Aug.	1½	1	3	8½	3	..	1	1	..	..	2	1½	1	..	1½	1	5	S.W., strong, seven days snow, mist, fog; varying breezes, fresh, and often in gusts.
Sept.	1	2½	1	1½	..	..	1	4	1	5	..	1	..	2½	1½	..	..	S.W., strong, seven days snow, mist, fog; varying breezes, fresh, and often in gusts.
Total	11½	4½	8½	7	5	2½	2	8	3	6	2	2½	1	2½	4½	1½	8	

The figures indicate the number of days during which the wind has blown from the quarter stated in the first horizontal column.

published in Captain Parry's voyage, who from September, 1819, till August, 1820, remained between the parallels of 74° and 75° North latitude.

Summary of observations made on board the *Hecla* during an interval of twelve months, in which period the vessel was in the latitudes of 74° and 75° N.

Months.	Thermometer.			Barometer.		
	Max.	Min.	Mean.	Max.	Min.	Mean.
1819.						
September ..	+37 ^o	- 1 ^o	+22 ^o 54	30.42	29.36	29.90
October	+17.5	-28	- 8.46	30.33	29.10	29.81
November ..	+ 6	-47	-20 60	30.32	29.63	29.94
December ..	+ 6	-43	-21 79	30.75	29.10	29.86
1820.						
January	- 2	-47	-30.09	30.77	29.59	30.07
February	-17	-50	-32.19	30.15	29.32	29.76
March	+ 6	-40	-18.10	30.26	29.00	29.80
April	+22	-32	- 8.37	30.66	29.40	29.97
May	+47	- 4	+16 60	30.48	29.25	30.10
June	+51	+28	+26.24	30.13	29.50	29.82
July	+60	+28	+42.41	31.01	29.13	29.66
August	+45	+28	+29.68	30.08	29.46	29.73

Remarks.—The thermometer when placed on shore or on the ice at a distance from the ship invariably stood from 3° to 4° or 5° , and even on some occasions 7° , lower than on board. The mean temperature for the year may therefore be fairly considered as -2° . The lowest temperature registered on the ice was -55° ; it did not rise above -54° for seventeen hours on the 14th and 15th of February, 1820.

The two preceding tables conclude the observations on the Arctic region of North America, and, in order to render them as complete as possible, we further give the table of observations also made by Captain Parry in his third voyage to discover the North-West passage. These observations embrace a period of sixteen months—from June, 1824, to September, 1825.

Observations made at Port Bowen in lat. $73^{\circ} 49' N.$ and long. $87^{\circ} 25' W.$

Month	North.	N.E.	East.	S.E.	South.	S.W.	West.	N.W.	Var.	Calm	Remarks on the Weather.
1824-5											
June	2	11	1	8 $\frac{1}{2}$	3	...	2	2	..	..	Much fog and rain; fine with E. wind.
July	9 $\frac{1}{2}$	5	3 $\frac{1}{2}$	5	2 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	5 $\frac{1}{2}$	..	..	Wind variable and weak; foggy.
Aug.	3 $\frac{1}{2}$	1 $\frac{1}{2}$	3	7	8 $\frac{1}{2}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$	7	1 $\frac{1}{2}$	..	Remarkable for rain and snow.
Sept.	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4 $\frac{1}{2}$	9	..	2	9	1 $\frac{1}{2}$	..	1	Breezes fresh and gusty.
Oct.	4	2 $\frac{1}{2}$	10 $\frac{1}{2}$	6 $\frac{1}{2}$	1	..	3	5	1	..	Fresh E. breezes; snow and fog.
Nov.	2	..	8 $\frac{1}{2}$	8	..	2 $\frac{1}{2}$	1 $\frac{1}{2}$	5 $\frac{1}{2}$	2	..	Wind by gusts; clear with N.W. wind.
Dec.	4	1	15	4 $\frac{1}{2}$	..	1	1 $\frac{1}{2}$	2	2	..	Fine with E. wd.; clear, a little snow.
Jan.	3	2 $\frac{1}{2}$	18	1 $\frac{1}{2}$	..	..	..	3	3	..	Very fine month; few storms.
Feb.	3	2	18 $\frac{1}{2}$	..	..	..	1	2 $\frac{1}{2}$	..	1	Ditto.
Mar.	..	1 $\frac{1}{2}$	18	..	..	2	2	7 $\frac{1}{2}$	1	..	Fine; some storms.
April	2 $\frac{1}{2}$	..	18	2	..	..	4	2 $\frac{1}{2}$	1	..	Fine; a few storms; a little snow during five days.
May	3	3	0 $\frac{1}{2}$	1	3	1	2	7 $\frac{1}{2}$	1	..	Strong breezes from S.E.; dull weather, squalls, snow.
June	1 $\frac{1}{2}$	1	12 $\frac{1}{2}$	2 $\frac{1}{2}$	2	4 $\frac{1}{2}$	2 $\frac{1}{2}$	5 $\frac{1}{2}$	..	..	Stormy; wind variable; misty.
July	4	1	..	5	2 $\frac{1}{2}$	3	12	4	..	..	Weather generally cloudy.
Aug.	9	8 $\frac{1}{2}$	1	..	1 $\frac{1}{2}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$	7	..	..	Cloudy, mist, rain, light breezes.
Sept.	1 $\frac{1}{2}$	3	3 $\frac{1}{2}$	1	5 $\frac{1}{2}$	3	4 $\frac{1}{2}$	6	..	..	Cloudy, rain, fog, light breezes.
Total	32 $\frac{1}{2}$	35	158	54	30	28	45	74	14 $\frac{1}{2}$	2	

This may conclude the Arctic observations with the remark that in the Arctic region the winds are variable and irregular; while they are generally moderate in all seasons of the year.

Hudson Bay.—In Hudson Bay it is observed that from October to May the prevailing winds are from North to N.W., and from June to October from S.E. to East. The northerly winds are very strong, and in spring and autumn squally tempestuous weather is most common.

Canada.—According to some writers, we find in Canada winds blowing regularly from North during five winter months. According to others, N.E. and S.W. winds prevail alternately; the former at the end of autumn and during winter, the latter during the remainder of the year. From December to April, the

weather is generally serene. The occasional N.W. winds which blow at this period are colder than those from N.E., and are common while the ice lasts. They are only met at sea in these regions about the month of March. They increase in June, and afterwards gradually diminish. The following table contains a summary of the winds observed during the year 1834 in Lower Canada.

Months.	Winds.	Remarks on the Weather.
January	W.N.W.	Weather generally fine.
February	W. and E.N.E.	Much snow.
March	W. and E.	Snow and rain.
April	Variable.	Generally fine.
May	Ditto.	Ditto.
June	Ditto.	Ditto.
July	Ditto.	Ditto.
August	Ditto.	Ditto.
September	Ditto.	Rain and cloudy weather.
October	E.N.E.	Snow and rain.
November	S.S.E.	Snow.
December	W.N.W.	Variable.

Newfoundland.—On the East and South coast of the island of Newfoundland the winds most generally found are from South from May till October. They are, however, very changeable, and generally moderate during this period. Nevertheless, there are occasional squalls from S.E., with rain and fog; which latter is especially prevalent in July and August. The N.W. winds which occasionally blow are dry and cold, and generally attended with a clear sky. In October these winds become violent. S.W. winds are also found here, but very variable in strength, at all times of the year.

Nova Scotia.—The following is a summary of observ-

ations of the winds at Halifax on the East coast of Nova Scotia.

Months.	Winds.	Remarks on the Weather.
January	N., S., and W.	Clear, rain, snow.
February	N.W. and var.	Clear, rain, cloudy.
March	N.W. and S.W.	Ditto.
April	West.	Ditto.
May	N. and W.	Clear and rain at intervals.
June	W., N., and N.W.	Ditto.
July	W., N., and S., var.	Clear and misty.
August	W. and S., var.	Clear, cloudy, rain, mist.
September	N.W. and S., var.	Ditto.
October	S.W., N., and N.W.	Clear.
November	W. and S.W.	Clear, rain, mist.
December	N.W. and N.E.	Clear and rain.

New Brunswick.—In New Brunswick the following observations have been made at Fredericton, the capital of this colony, by Sir James MacGregor.

Months.	East.	South.	West.	North.	Var.	Fine.	Rain.	Mist.	Snow.
January	4	..	7	6	14	24	3	1	4
February	3	4	4	3	16	23	1	..	4
March	23	2	5	..	1	22	2	2	5
April	13	4	11	..	3	22	7	..	1
May	20	1	7	..	3	18	8	5	..
June	19	1	10	..	..	15	6	9	..
July	20	..	7	2	2	18	3	10	..
August	17	..	9	4	1	23	3	5	..
September	17	..	10	3	1	17	5	8	..
October	14	..	8	..	9	23	7	2	..
November	11	5	..	14	..	15	8	3	4
December	..	..	9	14	8	26	..	2	3
Total	159	17	87	44	58	245	52	47	21

East Coast of North America.—On the East coast of North America the wind is neither constant nor uniform. The limits of the trade wind extend more northerly on this coast than on the opposite one of Africa, and reach the parallel of the Bermudas, and sometimes even as

far as 32° North latitude. The wind becomes more easterly as it nears the coast. In this part of America, which comprises the United States, the most frequent winds are from N.W. to S.E. In winter they are generally from N.W., and are most frequently dry. Winds from East, E.S.E. and S.E., produce rain, and the latter often very severe.

Cape Hatteras is celebrated for the constant bad weather it enjoys during the greatest part of the year. On this coast, says Franklin, hurricanes from N.E. are found; they first visit the S.W. part of the United States, in Georgia, and from thence extend successively over the country in their progress to the North, sometimes reaching Newfoundland. These violent winds last sometimes for two or three days, accompanied by rain and dense clouds.

Gulf of Mexico.—In the interior of the gulf of Mexico the trade winds are generally found, but only near the coast in proportion as the local winds found there diminish their force.

The Northers.—From May to September, in the gulf of Mexico, during June, July and August, is the season of the Northers: these winds are extremely violent, and sometimes accompanied with rain. The most violent are called *Hueso Colorados*; the more moderate *Chocolateros*; and they are found as far as the Bahama Channel. The Northers of the gulf of Mexico are announced by a heavy swell getting up in the bay of Campeche, by considerable humidity in the atmosphere, and by a dark cloud seen in the N.W. in the morning and evening, keeping 9° or 10° above the horizon, for

two or three days sometimes, before the Norther arrives; lightning in the N.W. and N.E., and gossamer floating in the air and hanging in the rigging, called *hilos de la vierga*; all these, as well as the phosphorescence of the sea, are indications of the approaching Norther. The wind commences first with a light air from South,—and then makes the round of the compass by West, and when it arrives at N.N.W., blows with all its violence. These breezes, which are very dangerous in the gulf of Mexico, generally last two or three days. When the wind is N.W., if the black cloud abovementioned begins to disappear, the gale will last but a short time, and the wind, which is then much less, hauls to the East, and if it becomes N.E. the weather moderates. These breezes are often attended with much rain, and heavy cloudy weather, and they necessarily produce a very heavy sea.

Dry Season.—The Northers of the gulf of Mexico prevail from the middle of March till September, which is the dry season. These winds in September and October are stronger than at other times, and if they are not found at this period, the trade winds are interrupted by storms and rain. In November they are quite settled, with considerable strength, and continue during December, January and February. In March and even April, when they blow they are light, and are then stronger at daybreak than in the preceding months; they also *veer to the N. W.*

Damp Season, or Season of the Trade Winds.—The damp season on the coast of the gulf of Mexico, prevails from March to September. From the end of March

and during April the trade winds from E.S.E., interrupted from time to time by North winds, are sometimes attended with a clear sky, at other times with a sky overcast; they veer towards S.E. and last all night. From July to October, the period when the North winds prevail, violent storms, accompanied by thunder, lightning, and heavy rains, are frequently experienced. Those from East are the most severe, but of the least duration.*

Hurricane Season.—The period of hurricanes in the gulf of Mexico, like the Antilles, is principally from August to October;† and the rainy season, called the winter in these regions, like the opposite on the coast of Africa, commences when the sun reaches the zenith of the place, passing to the North; and terminates when it again reaches the zenith of the same place, passing to the South.

Bahama Channel.—In the Bahama Channel the trade wind from N.E. in winter is interrupted by North winds, and in summer by calms. In winter, that is to say, from November to April, we find winds changing from East to South, and from South to West. In December and January there are frequently North winds, changing to N.W., blowing violently for seven or eight consecutive days.

In summer, from May to September, the prevailing

* Bernardo de Orta: *Derrotero de las Antillas*.

† We do not allude now to the hurricanes of the Atlantic Ocean. In the Indian Ocean we have collected all the facts relative to these terrible phenomena, and pointed out the laws observed by authors in their progress. See *Storm Compass*: by A. B. Becher, Captain, R.N., published by Potter, 31, Poultry.

winds of the Bahama Channel are from S.E. to S.W. by the South. During March and April southerly winds are frequent.

East Coast of Florida.—From the parallel of 28° North latitude to the Florida Cays, the trade wind blows till noon, and shortly after is followed by the sea breeze. This takes place regularly during summer: in winter, principally from November to March, the winds blow from South to West, and bring a heavy sea.

West Coast of Florida.—On the West coast of Florida, even as far as 28° North latitude, alternate land and sea breezes prevail.

Pensacola.—At Pensacola, chiefly from April to July, in the morning the wind is from North to East, or from East to South, followed in the afternoon by the wind from S.W. These S.W. winds (from sea) are termed *Virazon*; they blow in squalls in August, September, and October, a period when hurricanes are also experienced. From November to March northerly winds prevail; they begin at S.E. and South, with much rain; then veer to S.W. and West, at which point they remain some time, blowing very strong till they shift to N.W. and North; the weather then becomes fine.

Coasts from the Mississippi to the Bay of San Bernardo.—From the mouth of the Mississippi to the bay of San Bernardo, land breezes are found at daybreak from April to August. A short time after daybreak the wind veers to East and S.E., and blows from S.W. in the afternoon. In July, August, and September, squalls are frequent, with rain; there are, besides, southerly winds, changing from South to S.W. in squalls, which

last several successive days. The worst months for navigating this coast, are those of August, September, October, and November, because the winds are severe, and blow dead on shore, without permitting a vessel to carry as much sail as will take her out to sea. In February, March, and April, there is much fog at the entrance of the Mississippi. From December to March there are frequently strong northerly winds; and if these winds veer to East or South of East, the weather becomes dark, cloudy, or foggy.

Coast from the Bay of San Bernardo to Tampico.—Between the bay of San Bernardo and Tampico winds from S.E. continue from April till August; during the other months of the year strong winds from East and E.S.E. are found on that coast, lasting two or three days before blowing from North. During the fine season, the land breezes prevail regularly from eleven or twelve at night to nine or ten in the morning.

Tampico to Vera Cruz.—On the coast from Tampico to Vera Cruz, from April to July, the winds during the day blow from East, changing to E.S.E.; during the night they veer to South and S.W.; that is to say, they blow off the land. If the land breeze, on the contrary, shifts to N.W., accompanied by a little rain, the next day the wind generally comes from North of N.N.E. or N.E., especially in August and September. The land winds are termed *Vientos de cabeza*, (head winds,) or *Vendavales*. These winds are generally light: they do not reach further than twenty or thirty leagues from the coast, at which distance they blow from East or E.S.E.

Vera Cruz.—At Vera Cruz the winter season commences towards the middle of May, and terminates towards the end of July, when there are frequent interruptions in the trade winds, much fog, and stormy weather. From the end of July to the middle of October, the period when northerly winds prevail, storms are heavy.

The most violent winds are from East, but do not last long. Northerly winds prevail from the middle of October till March, but they generally fall at sunset, blowing strongest from nine o'clock in the morning till three in the afternoon. This is not the case if the wind only gets up in the afternoon or evening, in which case it continues to blow during the night, gradually increasing in force. At night, and after midnight, the wind changes, and shifts to N.W., blowing from the land. In this case if towards morning it veers to S.W., the North wind will not last, and the sea breeze will follow at the usual time, about nine or ten in the morning; but if this does not take place towards sunrise, or at latest at the beginning of tide, the North wind will again blow with as much force as on the preceding day; it is then called the North tide wind. The North wind often terminates by shifting to East, a guarantee of fine weather. If in the afternoon it veers to N.E., the sky will be cloudy the next morning; when the land breeze has come from South to West during the night, a sea breeze may be expected in the evening.

The weather then continues fine during five or six days; the longest period of fair weather with northerly winds. In case of the winds backing from N.E. to

N.N.E. and North, the weather is uncertain.* An attention to these peculiarities of the winds is important as affecting the approaches to the coast of Vera Cruz.

Coast of Yucatan from Vera Cruz to Point Arenas.—On the coast of Yucatan, from Vera Cruz to Arenas, we find, during the dry season, alternate land and sea breezes. The sea breeze from North, the land breeze from South, from seven or eight o'clock in the evening till eight or nine in the morning. The dry season lasts from September till April or May. The rainy season follows, and continues till September; it is announced by tornadoes and violent storms, which become more frequent in May and June. The great rains fall in July and August, being then continuous and very heavy. In this season there are sometimes strong winds from E.S.E., lasting three or four days.

Winds from North to N.E. begin in October; they are very strong in December and January, and gradually fail towards March; in general they are fresh and dry, and stronger than common breezes.

Coast from Point Arenas to Cape Catoche.—On that part of the coast comprised between Point Arenas and Cape Catoche, the seasons are nearly the same as the foregoing, only the general winds are from N.E., interrupted by strong North winds. In April tornadoes occur from N.E. to S.E. This squally weather lasts till September, during which sea breezes set in from N.N.W. to N.W. These breezes rise at eleven o'clock in the morning and during the night veer to East and E.S.E.,

* Bernardo de Orta: *Derrotero de las Antillas.*

and afterwards to S.E.; which last may therefore be regarded as land breezes.

It has been observed here, that the stronger the wind is from N.N.W. to N.W. the more violent are the tornadoes. On this part of the coast it has also been remarked that the rainy season is shorter than on the neighbouring coast westward.

Antilles.—The N.E. trade wind prevails particularly over that portion of sea called the Caribbean Sea. When approaching the shores of these isles, however, disturbances are found in these winds. Thus: on the shores of the Great Antilles, Cuba, Jamaica, St. Domingo, and Porto Rico, the sea breeze blows regularly during the day, and the land breeze during the night. The land breezes are fresher than those observed near the coast, and are favourable for making passages from West to East in this sea.

In the Lesser Antilles the land breeze is not met with, or if it should be it is at so short a distance from the shore as to be useless in navigation. In these islands two seasons are observed,—the dry and the rainy. Their periods vary in the different islands; but it may be stated generally, that the first lasts from October to June, and the second from June to October. During the dry season the N.E. trade wind blows regularly and fresh, with a clear sky. From June to October (the winter season) tornadoes and severe hurricanes are experienced, between the 15th of July and the 15th of October. In the Antilles the hurricanes blow from the West. This is a necessary consequence of the focus of the hurricane passing to the northward of them, as it usually does.

Hurricanes rarely penetrate into the gulf of Mexico ; some, however, have crossed the gulf, and continued onward beyond Vera Cruz. Amongst others, those of the 18th of August, 1810, and June 23rd, 1831.

We quote the following statement of the course of the hurricane in the Atlantic from a little pocket treatise on Hurricanes. " In the Atlantic Ocean, it is shown by Redfield that their average place of commencement is in the latitude of 15° N., and longitude 55° W., or about N.E. from the island of Trinidad. From thence they pursue a W.N.W. course, until arriving near the coast of Florida they follow the course of the Gulf Stream to the N.E., sweeping past the coast of the United States, and continuing far beyond the eastern limits of Newfoundland. Some, originating South of those, have maintained their western course beyond the gulf of Mexico ; and others, again, North of them, have assumed their N.E. course, passing between Bermuda and the American coast. But the North Atlantic hurricane mostly commences N.E. of Trinidad, within the parallels of 10° and 20° N. and between 50° and 60° West longitude."*

Calm and Storms.—Under the wind off the high land which forms the greater part of the Antilles, calm is experienced, interrupted by violent and very dangerous squalls, coming down from the declivities of the mountains ; and it is only at two or three leagues off at sea that the regular breeze is again found. These tricks of

* *Storm Compass ; or, Seaman's Hurricane Companion*, by A. B. Becher, Captain, R.N., p. 5. Potter, 31, Poultry, London.

the wind announce their approach by a shrill whistling, and sometimes by an agitation of the surface of the sea. They must not be trusted in sailing by the wind from the islands, and great care is necessary in looking to the sails. Vessels have been dismasted by these breezes, and many have been capsized even at the entrance of the bay where they had intended to anchor. During winter strong tide rips are found in most of the bays of the Antilles, generally after calms or light airs.

Cuba.—At Cuba the rainy season is from June to September, and the N.E. trade wind blows over the whole island from March to October. During the other months it takes frequently a northerly direction, changing to N.W.; it is then sometimes very strong. In the fine season, the sea breeze is regular on the North coast; it commences towards eleven o'clock or at noon, and towards evening gives place to the land breeze. It is found, however, that the trade wind prevails on this coast of the island, and that winds from South to East frequently prevail in the morning, and shift from E.N.E. to N.E. towards evening. At Havana the sea breeze generally sets in about ten o'clock in the morning.

On the South coast there are alternate land and sea breezes, the land wind commencing shortly after sunset.

The Bahama Isles.—The following observations of one year were made at Nassau, in the isle of Providence:—

Months.	Winds.	Remarks on the Weather.
January	S., N.E., N.N.E.	Strong breezes and cloudy.
February	N.E., S.E., N.E.	Moderate and variable.
March	N.E., S.E., N.E., N.	Clear, but breezy.
April	E., N.E., S.E., N.W.	Clear, a little rain.
May	Variable.	Moderate, showery.
June	Ditto.	Clear and dry.
July	S.E., E., S., N.E.	Light and clear.
August	N.E., E., N.W., S.	Squalls, with rain.
September	Ditto.	Clear, rain, and fog.
October	E., N.E., N.W.	Light, rain, and squalls.
November	S., S.W., W., N.W.	Moderate and squally.
December	S., S.W., N.W.	Variable, light, clear.

Jamaica.—In the island of Jamaica the alternate land and sea breezes are well established during the fine season; the former extend four leagues from the coast and cease towards four in the morning. The following are observations made on the winds of this island:—

Months.	Winds.	Remarks on the Weather.
January	N. and S.E.	Fine, small rain; strong winds from N.
February	Ditto.	Fine and dry; strong sea breezes.
March	Ditto.	Ditto.
April	Ditto.	Very dry; breezes moderate.
May	Ditto.	Fine; some showers.
June	Ditto.	Generally fine; heavy rain.
July	Ditto.	Much rain; fine by intervals.
August	S.S.W.	Some heavy rains.
September	S.S.W. and S.E.	Fine mornings; rain in the afternoon.
October	Ditto.	Heavy rain by intervals; generally fine.
November	Ditto.	Ditto.
December	Ditto.	A little rain; generally fine.

On all the coast of this island alternate land and sea breezes are found, and their directions vary according to that of the coasts. The sea breeze commences about eight or nine a.m., increases till noon,—sometimes till four p.m., and afterwards diminishes, to give place to the land breeze, which ceases towards four or six o'clock in the morning.

Porto-Rico.—At Porto-Rico rain falls from June to August. The trade winds blow from N.E. The sea breeze commences at eight in the morning and lasts till four in the afternoon, when it is followed by the land breeze.

St. Domingo.—The winds in the island of Hayti or St. Domingo vary on different parts of its shores. The winter season lasts from the end of April till November. During this season squalls of wind and storms are frequent; and strong winds from S.E. are found in the bay of Gonaives and in the channel of St. Mark. In November, December, January, and February northerly winds, changing to N.W., blow violently, principally on the North coast of the island. On the South coast, in June, July, and August, there are frequent storms, with the wind, from South, blowing violently. On the shores of this island, the land wind, which is generally very light when it does blow, is not to be depended on.

Lesser Antilles.—The following observations made at Trinidad and Dominica will give a general idea of the winds met with in the Lesser Antilles. The first table is for the Isle of Trinidad :—

Months.	Winds.	Remarks on the Weather.
January	E., E.N.E., E.S.E.	Cloudy, rain.
February	E. and E.N.E.	Cloudy, heavy dew.
March	Ditto.	Fine, dry.
April	E.N.E.	Fresh breezes.
May	S.E. and E.N.E.	Strong winds, thunder.
June	E.N.E. and E.S.E.	Rainy, breezes.
July	E.N.E.	Tempests, rain, and storms.
August	E.S.E.	Heavy gusts of wind, rain, and storms.
September	Ditto.	Heavy rain, storms.
October	Ditto.	Strong breezes.
November	E. and E.N.E.	Fine and warm occasionally.
December	Ditto.	Cold.

The following table is for the Island of Dominica :—

Months.	Winds.	Remarks on the Weather.
January	E.N.E. and N.	Cloudy.
February	E.N.E. and S.E.	Cold.
March	N.E. to S.E.	Fine, sometimes cloudy.
April	E.N.E., S.E., S.	Fine, moderate breezes.
May	N.E. to S.E. and E.	Calm, weather clear.
June	S.E., E., to N.E.	Calm, fog, and rain.
July	Ditto.	Calm, nights cold.
August	S.E. and N.E.	Calm, nights cold, storms and gusts.
September	S. and S.E.	Generally fine, rain at intervals.
October	N.E. to S.E.	Cloudy and fine alternately.
November	Ditto.	Fine and dry.
December	Ditto.	Fine, dry, and cold.

East Coast of Yucatan, Vera Paz, Honduras, and Mosquito.—On the eastern coast of Yucatan, that of Vera Paz, Honduras, and Mosquito, which form the western coast of the Carribbean Sea, the N.E. trade wind prevails in February, March, April, and May, but is sometimes interrupted (principally during the two first months) by northerly winds. In June, July, and August the winds on these coasts vary from East to West by the South, attended by squalls and calms. In October, November, December, and January the winds are from South to North, changing by the West, with squalls from W.S.W. to W.N.W., shifting to the North.

On the coast between Cape Gracias a Dios and Cape La Vela the winds are very changeable. From March to November they blow from N.E. to East, but are often interrupted by tornadoes in May, June, and July. Between the months of October and March, particularly in December and January, the wind occasionally comes from West; it is not strong, but sometimes lasts during

seven or eight days, and is then followed by N.E. winds.

While the westerly wind is strong on this coast, lasting for some days, the trade wind from East nevertheless is blowing out at sea as at other times. It is met with at a distance of eight or ten leagues from Cape La Vela at the same time that the westerly winds are blowing on the coast near this cape.

Porto Bello.—At Porto Bello, and between this point and Cartagena, the wind is N.E. from the 15th of November till the 15th of May. At the end of May it veers to S.W. and W.S.W., and reaches as far as lat. 12° N. These winds from S.W. and W.S.W., which are sometimes very violent, bring rain. At twenty leagues seaward from Porto Bello the wind blows from South in the interior of the gulf, veering to N.E.; the South winds generally extend eight or nine leagues from the coast. The winds from S.W. and W.S.W. are termed *vendavales*.

Cartagena.—At Cartagena during the fine season, from the middle of December till the end of April, the wind is generally from N.E. From May till November (the winter season) rainy and stormy weather prevails. During the fine season N.E. winds become settled towards the 15th of November. In the rainy season S.W. and W.S.W. winds extend as far as lat. 12° N.; beyond which the wind takes a N.E. direction. In November and December there are strong breezes, with much rain. During the winter season tornadoes are frequent on the coast.

Coasts of Caracas and Cumana.—The trade winds

take their usual course on the coasts of Caracas and Cumana as far as Cape La Vela; but from this cape to the point of St. Blaize their direction varies from N.E. to N.N.E. During the months of March, April, May, and June they are more regular, blowing with great violence from E.N.E. These strong breezes extend from the middle of the channel to within two or three leagues of the land, and diminish in force as they near it. On these two coasts, and even as far as the gulf of Nicaragua, the rainy westerly winds to which we have already alluded, called vendavales, are found from July to December, and sometimes till January.

Coast of Guiana.—On the coast of Guiana the trade wind only is found. From January to March it is from N.N.E. and E.N.E. In April, May, and June there are variable winds and calms. Afterwards the trade veers to E.S.E. and S.E., blowing from S.E. principally between June and December. The dry season is from January to June, and the rainy season is attended by continual storms.

The following table shows the state of the winds and weather at Demerara :—

Months.	Winds.	Remarks on the Weather.
January	East.	Cold, fresh breezes.
February	N.E.	Thick clouds with tempests, stormy.
March	E.N.E.	Clouds, very heavy showers.
April	East.	Heat, no rain.
May	N.E.	Thick clouds, frequent lightning, rain.
June	S. and Variable.	Hot, and rain at intervals.
July	East and South.	Hot and very heavy.
August	South.	Hot, rain at intervals.
September	South and East.	Heat, thunder and lightning.
October	Variable.	Light breezes, showers.
November	North and East.	Ditto.
December	N.N.E.	Heavy rain, breezes cold.

On the coasts of French Guiana the winter season begins in November and ends in July; the dry season lasts from July to November. Winds from E.N.E. blow during the first period; those from E.S.E. during the second. The rainy season is from December to February, and sometimes till March; it even begins sometimes sooner,—about the 15th November. In March and April there is an interval of three weeks or a month during which time the rains cease. This period in French Guiana is termed the March summer. The rain begins again towards the middle of April, and terminates in the middle of July. The interval between the rains is called the *poussaière*. From November to March the winds are from N.N.E. to N.E.; during March and April they change from East to South; from May to June they return to N.E., calms then are rare and there is no land wind. It is observed at Guiana that the dry winds are from East to South.

North Coast of Brazil.—On the North coast of Brazil, as far as Cape St. Roque, the trade winds blow from N.E. to S.E. From July to December those from S.E. to East prevail; from December to July those from N.E. to East. The month of June is the time when these periodical winds change, and which is the cause of the calms found near the land in that month, sometimes interrupted by squalls of wind and rain. The heaviest squalls are with the wind from East to N.E. At a short distance from this coast a land wind is often found during the night and morning, varying from S.S.E. to South, and ceasing towards eight or nine a.m.

East Coast of Brazil.—On the East coast of Brazil the winds are periodical. From September to March they blow from E.N.E. to N.E.; from March to September from S.S.E. to E.S.E. These winds do not extend more than forty or fifty leagues out to sea. Beyond this limit the trade wind is found, which generally blows between S.E. and East. On this limit, however, variable winds are met, between S.S.W. and S.E., with rain and storms. On the North part of this coast rain is frequent, as well as variable winds, in March and September,—the times when the change of winds takes place,—accompanied by heavy squally weather.

Bahia de Todos os Santos.—At Bahia the wind is E.N.E. from September till April. From April till August it is from South, changing from S.E. to S.S.W. In April it begins shifting to South and S.S.W. It is in greatest force during May, June, July, and August, and in these months is from S.E., varying to South and S.S.W. The seasons change in April and September. The wet season at Bahia begins in April, the same as on the coast of Brazil. The fine weather returns in September.

Rio Janeiro.—At Rio Janeiro the sea breeze, which comes from East, begins at eleven a.m., and reaches the roadstead and town towards two or three p.m., although the latter is only three leagues from the shore. The sea breeze lasts till sunset. The land breeze commences towards evening and lasts till morning, its duration and force depending on the season of the year.

Paraguay.—On the coast of Paraguay the sea breeze

sets in at nine or ten in the morning, and lasts till sunset.

River La Plata.—The winds in the River Plata and at the mouth of it follow the course of the seasons, but the form of its shores and their proximity exercise so great an influence on their force and direction that they are rarely the same as in the interior of the river. Thus sometimes a violent wind is blowing at Buenos Ayres which is not felt on the shore immediately opposite.

Almost all the pilots attribute great influence to the phases of the moon, and agree that it is difficult to foretell the weather correctly, the changes of the atmosphere being so sudden as to defy all their predictions. Storms gather and come down so rapidly that it is necessary to be always on guard against them. Instances of violent storms, called *pamperos*, are cited as coming suddenly when the weather was fine and clear, and announced only by a whirlwind: these, however, come only with a N.W. or westerly wind.

In this country the wind from S.W. is termed *pampero*. It is generally introduced by thick black clouds, which appear to roll hurriedly over each other; at other times by a large dark arch which invades the whole sky from West to East. The horizon quickly clears towards the S.W., and it is then that the pampero bursts forth with indescribable impetuosity. It is frequently accompanied by thunder, lightning, and rain; the coldness of the temperature is quite uncomfortable. The sky soon, however, becomes clear and the weather fine, and continues so during the rest of the pampero.

When the wind ceases it almost always veers to South

and S.E. Before the pampero bursts forth the barometer is very low; the mercury begins rising towards the end of the squalls, when the wind shifts to South.

In the River Plata, and also at sea in the same parallel, the winds are very changeable: during the fine season, from September to March, the prevailing wind out at sea is from N.E.; the horizon is charged with vapour, and the sky filled with clouds of indefinite forms. On nearing the river the wind veers to East, sometimes to S.E., very fresh, with rain and cloudy weather.

In the interior of the river, during this season, the wind from S.E. blows regularly in the afternoon; at night it falls and shifts to North: this wind is called a *virazon*: when it falls, and the wind from North to N.W. continues, a storm from S.W. (*pampero*) may be expected, more or less violent according to the *virazon*. We repeat, that great precautions are necessary against these storms; they may prove fatal to those who are not prepared to meet them.

About the times of full and change of the moon, strong breezes are found from S.E., with rain; sometimes also the wind blows from North, not so strong as that from S.E., and the temperature is higher.

The pilots say that the S.E. wind blows when the moon has South declination, and the North wind when she has North declination. In these cases the North wind generally shifts to N.E. in dry weather; if accompanied by rain or heavy dew it veers to N.W. It often becomes violent, blows in squalls from this direction, and ends by shifting to S.W., blowing strongly; with

this wind the sea rises suddenly, and subsides as soon as it ceases.

From March to September the general winds at the entrance of the Plata are from West to S.W. Ascending the river they are more frequently northward instead of southward of West.

The winter season is preferable to that of summer in the roadstead of Buenos Ayres; for the wind being generally from S.W. to N.W. the sea is smooth and communication facilitated.

In the months of July, August, and September there is frequently a thick fog from the mouth of the river to the shore of Ortiz; further up this is not so frequent.

The inhabitants of La Plata attribute these prejudicial influences to the North-wind: it is in fact very hot, and while it blows the air is charged with electricity: thus the wind from this quarter almost always terminates in a storm, during which it shifts to S.W. and restores the equilibrium.

Sometimes the pamperos extend out to sea, and pass the latitude of the island of St. Catherine. When it is clear they last longer than when the clouds are charged. What has been said respecting the winds of La Plata at sea, at its mouth, and in the interior, is what takes place in a general way; but the contrary must not occasion surprise, for the wind is so variable that neither its duration nor direction can be depended on with certainty: frequently during consecutive years at the same seasons the winds are widely different.

East Coast of Patagonia.—Ships leaving the Atlantic and bound for any port in the Pacific, will derive

advantage from keeping at least a hundred miles from the East coast of Patagonia, as much to avoid the heavy sea caused by the westerly breezes, which predominate in the East, and are stronger according to the distance from shore, as to profit by the variableness of the westerly wind. Near the coast, from April to September, when the sun has North declination, the wind is more from W.N.W. and N.N.W., than from any other quarter. Easterly winds are very rare, but when they do take place, as they come obliquely to the coast, there is no danger in keeping in shore.

During the opposite season, when the sun has South declination, the wind is principally from the southward of West, and sometimes very strong; but as the coast is to windward the sea falls with the wind. Although during this season the wind may not be fair, yet as it is rarely steady, and often varies six or eight points backwards or forwards in a few hours, advantage may be taken of this circumstance by keeping near the shore.

Terra del Fuego.—Fogs are very rare on the coast of Terra del Fuego; but dark and rainy weather, accompanied by violent winds, is generally experienced there. The sun appears but seldom, and even in fine weather the sky is dull and cloudy, and the atmosphere very seldom clear.

Different winds succeed each other at short intervals and last several days; sometimes the weather is fine for the space of a fortnight; but this happens very rarely.

The equinoctial months are the worst of the whole year about Terra del Fuego and Cape Horn. The winds

are then strong, but may not always be expected on the exact day of the equinox.

The months of August, September, October, and November, are also generally worse than the others. During these months westerly winds prevail, as well as snow, rain, and intense cold. December, January, and February, are the hottest months. The days are then long, and the weather sometimes fine. But in these months westerly winds prevail, sometimes very strong, and accompanied by much rain; for even the summer, in these latitudes, only possesses the advantage of longer days and a less rigorous temperature.

March is subject to storms, and is perhaps the worst month in the year, on account of the sudden squalls which then take place. It is, however, not so rainy as the summer months.

In April, May, and June, fine weather is general, and although the days shorten at this time, the weather resembles that of summer more than at any other period of the year. Bad weather is nevertheless found during these months; but the easterly winds, which are frequent, bring with them some fine days.

Passage from the Atlantic to the Pacific.—June and July are much alike, only in July the easterly winds are more frequent. The shortness of the days and the extreme cold render these months very unpleasant, although they are perhaps the most favourable for sailing from the Atlantic to the Pacific Ocean, because the wind so frequently blows from the East.

On the contrary, the summer months, namely, December and January, are the best for passing from the

Pacific to the Atlantic Ocean, though this passage is so short and easy that it may be attempted at all times.

In these regions thunder and lightning are little known. Violent storms are announced by heavy clouds coming from South and S.W.; they are accompanied sometimes by snow and hail of large dimensions, which render them still more formidable.

Westerly winds prevail during a great part of the year in these parts, and those about Cape Horn. The easterly winds only blow during the winter months now and then: they are however violent during this season, and are very rare during summer.

The easterly winds are always moderate, and accompanied by fine weather; when they begin blowing they gradually increase. The weather then changes, and the breeze perhaps becomes somewhat fresher: they often attain such a force as to require three reefs in the top-sails; then they gradually fall or shift to another quarter.

The North winds commence by blowing moderately, only the weather is more gloomy and cloudy than with an easterly wind; and a little rain generally falls. In proportion as the wind freshens, it veers westward, and increases in force, blowing between North and N.W. The sky then is very cloudy and dark, and rain falls abundantly. From N.W. it blows hard, and when its force is expended, (which it is in about twelve or fifteen hours,) or even while it blows hard from this quarter, the breeze suddenly shifts to S.W., and blows more violently than before. The wind disperses the clouds, and in a few hours the weather is perfectly clear; neverthe-

less, at times the squalls are very severe. The wind continues several days in the S.W. quarter, generally blowing very fresh; then it moderates a little, and, after two or three days, the weather becomes fine.

The North winds generally blow during summer, and it is a fact established from observation that the shifting of the wind from North to South takes place by the West during this season,—one which would little deserve its name were not the days longer and the atmosphere warmer. The winds and rain are much more violent during the long than during the short days.

It should not be forgotten that bad weather never comes suddenly from East, and that a S.W. or South wind never shifts quickly to North. On the contrary, winds from South and S.W. come on suddenly and with violence.

South winds and storms from S.W. are preceded and announced by thick masses of large white clouds rising in these parts, the borders of which are clearly defined, and which appear round and solid.

The North winds are preceded and accompanied by very low clouds, the sky is overcast, and some clouds appear above the rest. The sun can scarcely penetrate them and it assumes a reddish aspect.

Some hours and even a whole day before a North or N.W. wind the altitude of the sun cannot be taken, although it is visible, because the mist of the atmosphere prevents its disc from being distinctly seen.

Sometimes, but rarely, with a slight breeze, varying from N.N.W. to N.N.E. there are a few days of fine weather; South breezes and rain most generally suc-

ceed. The most common weather in the regions mentioned above, is a cloudy sky with a fresh breeze, varying from N.W. to S.W.

Falkland Isles.—It would be difficult to find a region more exposed to storms in summer and winter than the Falkland Islands.

The winds there are very variable, rarely falling while the sun is above the horizon, and sometimes very violent, even in summer. A day of calm is an extraordinary fact at the Falkland Isles. Generally, it blows less during the night than during the day; but, both by day and night, at all times of the year, they are exposed to sudden and violent storms and squalls of wind, though they do not, usually, last more than a few hours.

The prevalent wind is westerly. It generally begins from N.W., shifting to S.W. by West; and when the N.W. wind is attended by rain it quickly passes to S.W. and blows with strength from that quarter.

The North winds produce cloudy weather, and when they are light are accompanied by thick fog. It is also observed that they usually blow about the times of the moon's quartering. The winds from N.E. and North produce very gloomy weather, with much rain. They are sometimes strong and veer to N.N.W., but most frequently to West. S.E. winds also bring rain. They are rather frequent and blow strong, and in proportion as they strengthen they veer to the southward.

During winter the principal winds are from N.W.; and in summer from S.W. Although sometimes fogs attend the wind from East and North, they do not often last for a day,

The squalls of wind from the South, from S.W., and S.E. are more violent and sudden than those from any other direction. East winds are seldom strong, and last only a short time. They generally produce fair weather and may be expected more during April, May, June, and July than at any other time of the year. Intervals of fine weather are very scarce in the course of the year when the wind is varying between E.S.E. and E.N.E.

Thunder and lightning are very rare, and with the latter easterly winds may be expected. If lightning appears in the S.E., and the barometer is low, a heavy breeze of wind from that quarter will most likely follow.

These breezes from S.E. and South last longer than those from West, at least generally, and they cause a heavy surf on the South coasts of these islands. In winter the wind is generally not so strong as in summer, and during the former season the weather, though colder, is drier and better established.

All important changes are foretold by the barometer, provided the changes of the mercury are understood by those who consult it, and frequent observation is made.

Such are the general observations on the winds in the different parts of the basin of the Atlantic. We shall next proceed to consider the currents of this sea.

GENERAL VIEW OF THE CURRENTS OF THE
ATLANTIC OCEAN.

THE currents of the Atlantic are of two kinds: one occasioned by tides, and observed only at short distances from the coast; the other by causes differently explained; but almost constant in their direction, and deviating only near those coasts which impede their progress.

These last, called general currents, are divided into cold and warm currents, according to the waters of which they are composed. The result of all observations on currents may be thus expressed:—cold currents flow from the poles towards the equator on the western coasts of continents. Currents setting from East to West flow along the equator; warm currents flowing from the equator towards the poles pass along the eastern shores of great continents. Thus we find a cold current setting from North to South on the western coasts of Europe and the N.W. coast of Africa; a cold current from South to North on the S.W. coast of the same continent. But, on the contrary, on the coast of Brazil a warm current is found flowing from North to South; then a warm current, which after having circulated through the gulf of Mexico leaves it by the Bahamas, and flows along the coast of the United States, being known by the name of the Gulf Stream.

Such are the general currents of that vast basin, called the Atlantic Ocean, formed by an immense longi-

tudinal valley, separating the European and African continents from that of America. At present we will confine ourselves to the notice of these currents.

Philosophers differ as to the originating causes of these general currents. Some attribute them to the action of the trade winds; while the greater number admit that, like the winds, they are produced by the sun's heat, and by the rotatory motion of the earth. Thus, they say, in consequence of this movement, and the passage of the polar waters towards the equator, a current, apparently directed from East to West, must be formed at the equator, according to the same that takes place in the atmosphere and produced by the same cause.

Now, a constant current must necessarily produce a drain of the adjacent waters towards one of its extremes, say the eastern, and on the contrary a lateral displacement at the opposite one, the western; or, in other words, admit a flow of the polar waters towards the equator on the western coasts of the great equatorial continents, then on the contrary a flow towards the poles on the eastern sides of the continents must ensue. We may further observe that the equatorial waters as they flow onwards for the poles, on account of the greater velocity of rotation at the equator, as well as on account of the flow of the polar waters towards the equator, should follow a certain direction easterly from the West, like the Gulf Stream in the North Atlantic and the current of the South Atlantic flowing from the coast of Brazil towards that of Africa.

Equatorial, Polar, and Tropical Current.—We call

the equatorial current that which flows from East to West at the equator. We shall distinguish by the name of *polar currents* those flowing from the poles towards the equator on the western coasts of the continents; and by the name of *tropical currents* those flowing from the equator towards the poles on the eastern coasts of the continents. The velocity of these currents varies in different parts of their courses; the greatest that has been observed is from 60 to 120 miles in twenty-four hours. Their general temperature is higher or lower than that of the sea through which they pass, according to that of the climate where they originate. We shall now allude to the direction and limits of the Atlantic currents, showing their mean velocities and temperatures; and first those of the equatorial current.

Equatorial Current.—The equatorial current commences on the West coast of Africa in about $5^{\circ} 30'$ E. of Greenwich. It passes by the isle of Anno Bom and continues westward parallel to the equator between 1° and $1^{\circ} 30'$ N. lat. and 2° or 3° S. It soon extends itself northward and southward, and although it hardly passes North of the parallel of latitude abovementioned, it ranges abreast of Cape Palmas between $3^{\circ} 30'$ and 5° S. lat. For the space of a thousand miles, nearly as far as 12° or 14° W., along the equator in the gulf of Guinea it runs by the side of another current taking the opposite direction from East to West, called the Guinea Current. This part of the sea then presents the remarkable phenomenon of two currents adjacent to each other running with great velocity in opposite directions, and having a difference of temperature of about seven degrees; so

that imagining a vessel to be in either of these currents sailing eastward in the gulf of Guinea, her progress would be accelerated or retarded forty or fifty miles a day, that being the rapidity of the two currents in this part. We shall hereafter return to this important fact.

Advancing westward on each side of the equator, the equatorial current in 20° or 21° W. throws itself into the northern hemisphere under the name of the N.W. branch of the equatorial current, reaching to 20° N. lat., extending itself gradually, and sometimes is even felt as far as 30° N. Then again it also extends more southerly, and thus covers a space of three hundred miles, nearly reaching to Cape St. Roque, where it becomes divided into two distinct branches. The northern branch, which is the largest, forms the Guiana Current, and reaches to the Antilles; the southern branch, running parallel to the coast of South America, and extending far out to sea, forms the Brazil Current.

The Equatorial Current—Extent.—The length of the equatorial current from the coast of Africa to Cape St. Roque is 2,500 miles, and to the Antilles 4,000 miles. Its breadth near its origin is 160 miles; abreast of Cape Palmas 360 miles; and it runs for 450 miles before it divides.

Velocity.—This current has most velocity in summer and least in winter. Between the meridians of 5° E. and 8° W. long. its mean rate is from 25 to 30 miles a day. Between 8° and 14° W. long., towards the end of June and the beginning of July, it varies from 44 to 75 miles. Between 14° and 21° W. long., from 45 to 60:

its mean velocity may then be estimated at 46 miles in twenty-four hours.

Temperature.—The mean temperature of its waters is 73° , or about 4° or 5° above that of the ocean in different seasons.

The N.W. branch of the equatorial current, flowing first to N.W., assumes afterwards a more northerly direction. This current is always felt in 18° N. lat., and sometimes even as far as 30° . It is lost in the current produced by the N.E. trade, to which it appears to give a N.W. direction, besides increasing its rapidity. The width of this current at the point of separation is nearly 200 miles, and further North 300 miles. Its velocity up to 10° N. lat. is 20 or 24 miles a day; from that it gradually decreases. This current is important to ships passing to the northward from the southern hemisphere.

The general set of the waters towards the West in the zone adjacent to the equator, here alluded to, cannot be doubted. Nevertheless, several navigators have asserted that in the same zone, and for several days, they have experienced currents flowing to East. Some commanders have crossed the easterly current setting at a rate varying from $0.3'$ to $1.0'$ per hour.

These cases, we conceive, may be regarded as exceptions, and the currents as eddies or counter-currents on the limits of the general current. Some authors, however, mention the existence of a current running from West to East between 8° and 10° N. lat. It is felt first about 53° W. long., and will reach as far as 26° W. On the first meridian its general direction is between North and N.N.E., and in proportion as it advances to-

wards East it increases in breadth. It also increases in velocity till it reaches to about 38° W. long., and its direction becomes more easterly. Beyond the meridian of 38° its velocity decreases, while it becomes more extended, and it can hardly reach the longitude of 26° W. We recommend this current to the examination of seamen.

We have hitherto alluded to secondary currents, which philosophers attribute to winds blowing in the same direction for a longer or shorter period. The secondary currents, which owe their origin to winds as constant as the trade, are constant themselves, and flow in the same direction with nearly uniform strength. They are found in the Atlantic between the tropics, but are only considered regular between 23° N. lat. and 9° S. lat., the space in which the trade winds blow regularly, and they attain a mean velocity of nine or ten miles per day. The currents caused by the prevailing winds are neither constant in their direction nor velocity; they are found both North and South of the 32^{nd} degree of latitude.

The Guiana Current.—The Guiana Current, which is a continuation of the equatorial current, runs along the low coast of Guiana towards the isle of Trinidad. About the equator it is crossed by the waters of the Amazon, a river which, receiving an immense volume of water from tributaries, forms a counter-current to it, producing considerable overfalls. This, however, owing to the impetuosity of the fresh water, does not influence its direction. The river waters and those of the Guiana current do not intermingle with each other; for after crossing that current the river water is recognised at 300 miles from its mouth.

A little South of Trinidad the River Orinoco discharges a considerable quantity of water into the equatorial current. From the nearly similar directions in which they run the waters easily combine with each other, and the rapidity of the current is thus considerably augmented. It then enters the sea of the Antilles by the strait formed on one side by the isle of Trinidad and on the other by that of Martinique; in which space are the islands of St. Vincent, St. Lucia, Grenada, Barbados, and Tobago.

Current of the Carribbean Sea and Gulf of Mexico.

—In the Carribbean Sea no constant currents have been observed; and although in the midst of this sea and about the islands which bound it on the East and North variable currents are found, but generally setting westward, yet along the coast the general current still prevails, following the direction of the coast at a variable distance. Thus, it flows from East to West between the isle of Trinidad and Cape Agulhas; thence it proceeds W.N.W. and N.W. as far as Cape Catoche, crossing the gulfs of Darien and Nicaragua and the bay of Honduras; then it takes a complete circuit of the gulf of Mexico. Thus, after reaching Cape Catoche it turns westward towards the shores of Campeche, along the coast of Yucatan; it thence continues towards Vera Cruz, changes its direction and flows northwards as far as the Rio del Norte and even beyond that river; it flows afterwards N.E. till it meets the waters of the Mississippi; then takes a S.E. direction towards the Tortugas. At this point its direction becomes East, then N.E., and, lastly, North, following the Florida Channel,

and discharging a second branch across the Bahama Islands that loses itself in the Atlantic Ocean.

In the middle of the gulf of Mexico the waters do not appear to follow any particular course, as is the case in the Carribbean Sea, and they most frequently depend, as to strength and duration, on the prevailing winds.

The temperature of the sea of this archipelago has been generally found higher than that of the ocean of the same latitude; but, notwithstanding the increase of caloric carried to its water by the surrounding continents, it is considered that the high temperature of the Carribbean Sea arises in a great measure from the currents of heated water that penetrate it from the Torrid zone of the North Atlantic Ocean.

Velocity of the Guiana Current.—The Guiana current varies in strength during its course (which is about 590 miles) from 10 to 21 or 36 miles a day. It has been sometimes found to be four miles an hour, while near the coast it gradually diminishes to less than half a mile an hour.

Temperature.—The temperature of the waters of this current has been estimated at 80° ; that of the waters of the River Amazon very near the line of demarcation is also 80° . The line of separation between the waters of the Amazon and those of this current is N.W. $\frac{1}{4}$ N., and the two waters are as distinct from each other as two separate fluids.

Gulf Stream or Florida Current.—The Gulf Stream has its origin in the gulf of Mexico, and the waters having been heated there flow across to the Bahama Channel. Issuing from this strait they flow along

the coast of Florida, over 31° N. lat., in a more N.E. direction as far as Cape Hatteras. There, from the indentation of the coast, the West limit of the current takes a more northern direction, while its principal bed is still directed N.E. until it reaches the shoals of St. George and Nantucket, where its direction becomes more easterly. Soon after its direction is E.b.N., passing the southern extremity of the great bank of Newfoundland; and it preserves this direction, between 35° and 43° N. lat., till it reaches the meridian of 36° W. There it turns S.E. and South; afterwards, passing the archipelago of the Azores on the West, it loses itself in the ocean. Its warm waters have, however, been found sometimes on the West coasts of Europe; they have been recognised between the parallels of $44^{\circ} 20'$ and 39° , once also, among others, by Franklin.

Extent and Velocity of the Gulf Stream.—The course of the Gulf Stream is about 3,000 miles from its source to its termination West of the Azores. It traverses in this course nearly twenty degrees of latitude, —from the parallel of 23° to that of 43° .

According to observations made regarding this current, its mean velocity from the entrance of the Florida Channel, at the island of Bemini, to 31° N. lat., is about 70 miles in twenty-four hours. A mean speed of 80 miles a day has been found between the parallels of 26° and 27° N. lat., although a strong North wind blows against it. At the outlet of the Gulf Stream, off Cape Carnaveral, it is like a torrent, and sometimes attains 120 miles in twenty-four hours. It gradually decreases in strength in its progress to the East. Between the

meridians of 65° and 66° W. long. it is 55 miles a day ; and 'on that of $42^{\circ} 30'$ it is only 30 or 35 miles. The rapidity of the Gulf Stream afterwards diminishes more rapidly when it curves to the South or to the West of the Azores ; near these isles it does not run more than 10 miles a day.

Temperature.—The mean temperature observed in the waters of the Gulf Stream is 86° , which makes it 9° above that of the ocean under the same parallel ; ten degrees further North it is found to be 84° , having in this space diminished about 2° ; in 61° W. long. it is found to be 81° in summer, and 76° in winter ; in 43° W. long. 75° ; and in 38° W. long. 73° . Thus the temperature appears to decrease with the rapidity, but not so quickly, as the waters advance eastward ; but they still have a very high temperature when they turn towards the South. On coming out of the Bahama Channel, the waters of the Gulf Stream have a blue tinge, and the line of their separation from the waters of the Atlantic is perfectly evident for the space of a hundred miles.

N.E. Branch of the Gulf Stream.—At the place where the Gulf Stream curves towards the S.E., to the northward of the Azores, in 36° W. long., a portion of it continues in a considerable branch towards the N.E., about 600 miles in length, which continues towards the pole, passing between Iceland and the coast of Norway and surrounding the Ferroe Isles. The water of this current is warm, and its temperature in summer has been estimated at 54° ; in winter at 51° . Its direction is towards N.E. ; but there are very few data as to its rapidity. This current is important to ships bound from

the West Indies to Norway, Denmark, or to places situated on the northern coast of the North Sea.

Arctic Current.—It is considered that the arctic current takes its rise in the frozen regions surrounding the North Pole; from whence it descends along the East coast of Greenland towards Cape Farewell. It passes round the cape, a large portion proceeding along the West coast of Greenland till it reaches the latitude of 66° N.; it then turns and again flows towards the South, along the coast of Labrador, forming the current known by the name of the Hudson Bay Current.

In arriving at the North extremity of Newfoundland it sends a branch across the strait of Belle Isle, which mingles with the waters of the St. Lawrence and continues along the South coast of Newfoundland, while the principal current continues down between the Great and Little Banks of Newfoundland and meets the Gulf Stream between 41° and 45° W. long. It there divides into two branches: the one, flowing South towards the sea of Antilles, reaches that part by an under current; an hypothesis which serves to explain the presence of fields of ice met with in crossing the Gulf Stream. The other branch of the arctic current, flowing towards S.W., past the island of Nantucket, forms the counter-current of the United States, occupying the space comprised between the Gulf Stream and the coast extending from Cape Hatteras to that of Florida. The arctic current thus replaces the hot waters of the gulf of Mexico caused by the Gulf Stream.

This current facilitates very much the navigation of the coast of the United States from the northward. It

is a cold current, as we have said, and consequently it will be easy to keep in it by means of thermometrical observations, and also to avoid entering the Gulf Stream.

Although to the West of the Azores the current of the Gulf Stream turns partly towards the South, yet between the archipelago and the coast of Europe a general movement of the waters from West to East ensues. This current is known to mariners by the name of the "Bay Current." Can this current be produced by the warm waters of the Gulf Stream, or is it occasioned by the cold waters carried from the pole towards the equator, is a question which has not yet been solved.

The rapidity of the bay current is very variable; it is sometimes 10 or 14 miles a day, and sometimes 24. In the latitude of Cape Finisterre the direction of it is from E.S.E. to S.E., and it divides into two branches; one forming the Rennel Current, the other that of the coast of Portugal.

The Rennel Current.—The Rennel Current, which bears the name of the learned Major who first discovered its course, has an easterly direction near Cape Finisterre. It flows along the North coast of Spain, then proceeds North along the West coast of France, where it is felt at thirty or forty miles off shore, and is fifteen or twenty miles across. It has been found to run from one half to two thirds of a mile per hour. It is very variable, according to the strength of the wind and its direction. It is sometimes found to flow at the rate of a mile an hour, and to this current is attributed the loss of many vessels in the English Channel. It becomes wider as it proceeds northward; and in the latitude of Brest it is

eighty miles across, and its direction nearly N.W. It issues from the bay of Biscay, passes West of Ushant at fifteen or twenty miles from that island, crosses the entrance of the Channel, and takes a westerly direction from the Scilly Isles. At the entrance of the Irish Sea it discharges a second branch into that sea, the principal branch flowing W.N.W. and West, towards Cape Clear, and losing itself, near the meridian of 18° W. long. in the polar current towards Northern Africa.

The Portugal Current.—The second branch of the bay current, called the Portugal Current, flows from Cape Finisterre towards the S.S.E. and S.E. along the coast, on which, however, it partly approaches. Off Cape St. Vincent its direction becomes S.E., and proceeding South, it becomes more and more easterly towards the strait of Gibraltar; towards which, under the meridian of 18° W. long., all the waters comprised between Cape St. Vincent on the North, and Cape Cantin on the South, are directed, forming the Strait Current, which carries the waters of the ocean into the Mediterranean.

The velocity of the Portugal Current has been found to be from 12 to 24 miles a day. It is very variable, according to the prevailing winds, their strength and duration. This current, then, on the coast must never be trusted, especially in the winter or with strong N.W. winds, when it is necessary to keep well off the coast. The same attention also must be devoted to the current generally of the bay of Biscay, known as the Bay Current, and that of Rennel. These two currents are strong when the West winds, changing from N.W. to S.W.,

have continued long and with force. In this case it will be prudent to look out for the approaches of the English Channel, and on leaving the bay of Biscay to double Cape Finisterre well out to seaward.

This gulf, then, presents us with this important fact that while out at sea the waters are setting towards East, E.S.E., and S.E., as proved by a number of bottles found near Bayonne and the basin of Arcachon, the waters of the interior and near the coast of France make their escape towards the North and N.W.

Polar Current of Africa and Current of North Guinea.—The polar current of Africa takes its rise in that part of the Atlantic situated abreast of the coast of France. Between Cape Clear, of Ireland, and Cape Finisterre, of Spain, it flows South towards Cape St. Vincent. Between this cape and Cape Cantin of Morocco, the entire mass of water, as far as 18° W. long. flows to the S.E. and N.E. towards the strait of Gibraltar; through which the waters rush like the conduit pipe of a funnel. From Cape Cantin to Cape Bojador, between Madeira and the archipelago of the Canaries, it is directed more easterly and S.E.; but it does not extend in this part and in this direction further out than 150 or 180 miles from the coast. Further out at sea its direction is South and S.S.W. From the archipelago of the Canaries to Cape Verd its direction is generally from South to S.S.W. Afterwards, at Cape Verd, it flows towards South, a little easterly, following the coast of Africa, and takes the name of the North Guinea Current off Cape Palmas.

The western limit of the polar current, near Cape

Verd, is between the island of Sal and that of San Nicolas; afterwards between the island of Mayo and that of Santiago, in the archipelago of the Cape Verd Islands. Its direction is from South to S.W. nearly all throughout its course from its rising till it reaches this part. Off Cape Mesurado its direction becomes E.S.E., and even East out at sea; while at a little distance from the coast it is S.E. as far as Cape Palmas. Off this cape its direction out at sea is easterly; then E.N.E. as far as the gulfs of Benin and Biafra. It then meets with the equatorial current, and after having reached Princes Island the waters probably mingle with those of the equatorial current.

Extent of this Current—The width of the North Guinea Current varies according to the seasons. In the latitude of Cape Palmas it extends nearly 180 miles to seaward, that is, as far as 12° W. long.; and it occupies the space comprised between the parallel of $2^{\circ} 30'$ N. lat. and the North coast of Guinea. On the meridian of Cape Palmas it is nearly 150 miles across; but to the East, in the gulf of Benin, it attains to a considerable breadth, nearly 300 miles from North to South. It is not felt in the vicinity of Isle St. Thomas, neither is the equatorial current, which is only first found a little to the West of this island, in about 6° E. long.

Velocity of the Polar Current of North Africa.—The velocity of the polar current of North Africa near its origin on the coast of Portugal, is about 12 miles a day. On the coast of Africa it varies from 16 to 10 miles till it reaches Cape Palmas.

Velocity of the North Guinea Current.—The cur-

rent of North Guinea flows with the greatest rapidity from June to September. When East of Cape Palmas this is found to be 40 or 50 miles a day. Off Cape Three Points it is nearly 34 miles per day. It then decreases, and in the gulf of Benin its direction is from East towards the South.

Temperature of the Current.—Near the Cape Verd Islands, the temperature of the waters of this current is 8° or 10° below that of the waters of the ocean; it then increases rapidly in proportion as it proceeds South. In the gulf of Guinea the temperature of the water has been observed to be 84° in the middle of the current; 83° and 81° at its southern limit; in contact with the colder waters of the equatorial current it is 79° or 81° in the North part, adjoining the coast. This current is of the utmost importance in navigating the western coast of Africa.

Such are the general currents of the North Atlantic Ocean, the other portions of which are occupied by currents flowing from these; the principal of which, as above stated, is that flowing towards the West and S.W., caused by the constant trade winds from N.E.

North Atlantic Ocean—Comparative Table of the mean velocity of the Currents for twenty-four hours.

Equatorial Current	46 miles.
Guiana Current	30 "
Gulf Stream.....	33 "
Current caused by N.E. trade winds.....	10 "
Rennel Current	18 "
African Current and North Guinea	20 "

Brazil Current.—We have already spoken of the

current of Brazil, a southern branch of the equatorial current, dividing at Cape St. Roque. It extends 250 or 300 miles along the coast of South America, and commences from 6° or 7° S.

The space between the coast and this current is occupied by other currents which follow the direction assigned to them by the alternate S.E. and N.E. winds of the coast of Brazil. The current of Brazil is crossed by the waters of the River Plata, which may be recognized more than 200 miles from the mouth of that river. These waters do not, however, appear to produce much effect on the Brazil Current, which in these latitudes seems to divide into two branches. The most considerable, taking an easterly direction, forms the counter-current of the South Atlantic Ocean. The other branch, flowing southward, forms a current which, though very feeble, is sometimes felt as far as the entrance of the strait of Magellan. The mean velocity of this current in the part nearest the equator, is about 20 miles a day.

Alternate Currents of the Coast of Brazil.—We have said that between the coast of Brazil and the current of which we have spoken alternate currents are met with, occasioned by the periodical winds which blow on this coast. The force of these currents depends on the strength of the wind, and consequently is very variable. From March to September, when winds from S.E. to E.S.E. prevail, the current sets northward, and from September to March, with N.E. winds, veering to E.N.E., it sets southward; but these directions are much varied by the form of the coasts. This current

is felt only about 50 or 60 leagues from the coast of Brazil, and is of the utmost importance to navigation.

Current of Cape Horn.—The current off Cape Horn sets constantly from the Antarctic Sea and round the cape from the Pacific Ocean into the Atlantic, and is generally accompanied by strong westerly gales. Its general direction is E.N.E. and N.E. However constant may be the prevailing winds on the East coast of America, it flows to N.E., passing the Falkland Isles. In some seasons it preserves its N.E. direction as far as the parallel of 49° or 48° S. lat., and it is most probable that it joins the counter-current of the South Atlantic Ocean, of which we shall speak presently.

On the coasts of Terra del Fuego the rate of this current has been found to be 12 and 15 miles in the course of the day. In 57° S. lat. and 72° W. long. it is 35 miles. Near the coast its mean rate is about 24 miles. While between Cape Horn and Staten Land, in 55° S. lat., its direction is N. 51° E., and its rate 56 miles per day.

The waters of this current, flowing northward and partly coming from the Antarctic Polar Sea, have a lower temperature than those of the adjacent ocean.

That part of the South Atlantic occupied by the counter-current which flows from the coast of Brazil towards the Cape of Good Hope, is only partially known. It is considered in a great measure to be formed by the tropical current of the coast of Brazil; but this is not established as certain. It flows rapidly to the eastward, passing 150 or 180 miles South of the Cape of Good Hope. It then penetrates the Indian Ocean, and traces

of it are found more than 2,000 miles beyond the Cape, where it unites with the polar current of Australia. This current is very favourable to ships rounding the Cape to the eastward.

Current of the Cape of Good Hope.—The current off the Cape of Good Hope is formed of two others from the Indian Ocean: the principal of which flows southward from the Mozambique Channel along the African coast; the other coming from that part of the ocean southward of Madagascar, is the S.W. branch of the equatorial current of the Indian Ocean. These two Indian currents unite a little South of Port Natal, where they take a more southerly direction over the bank of Agulhas. Instead of then flowing entirely, as one might imagine, into the Atlantic Ocean, the greater portion of this returns by a counter-current into the Indian Ocean, mixing with the counter-current of the Atlantic, abovementioned, after the Agulhas Bank has modified the direction of the current off the Cape of Good Hope to the West. This current is known as the counter-current of the Cape of Good Hope.

South Atlantic Polar Current.—The other portion of the current off the Cape of Good Hope flows into the South Atlantic Ocean, following nearly all the western coast of Africa. This branch is called the polar current of the South Atlantic, or the South Atlantic Current.

At the point of junction of these two currents, near Cape Recife, the current of the Cape of Good Hope is 90 or 100 miles wide. In some parts its velocity is from 60 to 100 miles in twenty-four hours.

Temperature.—Beyond the bank off the Cape its temperature has been marked at 70° , that is, 9° above that of the ocean. Near the edge of the bank it is found to be 68° , namely 7° above the temperature of the ocean. On the bank itself the temperature of the water has been found 5° below that of the ocean.

The counter-current of the Cape of Good Hope, above-mentioned, is sometimes 210 and even 240 miles wide.

South Atlantic Polar Current.—The polar South Atlantic current, which, as we have seen above, is the only branch of the current off the Cape of Good Hope which penetrates the Atlantic Ocean, flows round the Cape of Good Hope, extending 80 or 100 miles out to sea, passing to the northward of the counter-current of the Atlantic Ocean. It increases off the Cape even to about 150 or 160 miles in extent. It then flows northward, enlarging more and more, when its principal direction becomes N.W. Near the Cape of Good Hope, and nearly in the same latitude, it receives a branch which appears to proceed from the counter-current of the Atlantic Ocean.

Velocity.—The rate of this current has been found generally 16 miles in twenty hours, in a N.W. direction generally. In its course it meets with the waters of the River Congo, flowing with great rapidity; but they do not appear to attain any decided influence over it, the direction of it and those of the current forming no considerable angle. The waters of the Amazon do not mingle with the ocean for a considerable distance, and at 200 miles from the river's mouth the more highly coloured water of the Congo may be perceived.

Temperature.—Near the Cape of Good Hope the temperature of this current is 67° , that is, 3° above that of the ocean. On the parallel of 30° S. lat. it is not more than 64° .

Current of South Guinea.—From St. Paul de Loando the current continues along the coast of Africa, flowing nearly N.W. Off Cape Lopez a portion of the principal current takes a more northerly direction, following the coast of Gaboon as far as the gulf of Biafra. It is there lost in the equatorial current and may be called the current of South Guinea. The principal direction it takes is N.N.E. and N.E. near the coast, and N.W. further at sea and near the iales of the gulf of Biafra. At sea the limit of this current appears to be to the eastward of Princes Island.

Velocity.—The velocity of it is often 24 miles per day, but is generally about 10; it is, however, very variable, sometimes ceasing altogether. Still, southerly currents are found in this part of the gulf of Guinea, but the circumstance is very rare.

Temperature.—The temperature of the current of South Guinea at its limit near the coast of Gaboon, has been found to be 77° , and in the middle of the bed of the current 77° and 79° . Thus it is 6° or 8° higher than that of the waters of the equatorial current. The knowledge of this current is very useful to vessels sailing towards Gaboon.

The vast portion of sea forming the centre of the South Atlantic, is occupied by currents produced by the S.E. trade wind: their general direction varies from West to S.W. and S.S.W. in proportion as the waters

approach the exterior limit of the current of Brazil, with which they mingle in order to return eastward by the cross current of the Atlantic.

South Atlantic Ocean—Comparative Table of the mean velocity of the Currents for twenty-four hours.

South Atlantic Current	15 miles.
Brazil Current.....	20 „
Counter-current of the Atlantic	15 „
Current of Cape Agulhas	80 „
Counter-current of the Cape.....	30 „
Current caused by S.E. trade	10 „
Current of South Guinea	10 „

GENERAL REMARKS ON THE NAVIGATION OF THE
ATLANTIC.

It is a general rule in the navigation of the ocean when going from East to West to attain, if convenient, the zone of the trade winds; and to avoid it when going in the opposite direction. In the first case, then, it becomes desirable to reach it, and in the other to leave it, as soon as possible.

Having treated on the prevailing winds and currents of the Atlantic Ocean, we shall now allude to the routes which should be taken for crossing it.

Routes from Europe to North America.—In these routes from Europe to North America, it is generally acknowledged that the further North the port of departure is the greater are the chances of a speedy passage.

In the beginning of the year it is advisable to keep North of 46° or 47° N. lat. as far as the meridian of about 32° W., and then to haul South to the parallel of 43° N., and keep in or near this parallel without making northing, especially in approaching the coast of North America, in order to pass well clear of Sable Island, this being so dangerous that it cannot be avoided too carefully. By following this route the northern limit of the Gulf Stream will be avoided, and after leaving Newfoundland the arctic current will assist in the track to the S.W. for the ports of Nova Scotia and New Brunswick, or those of the North United States.

Towards the end of the year it may be better to adopt a course to the northward of that. Thus, leaving Europe, proceed to the N.W. as far as 55° latitude and 30° W. longitude. From thence cross the banks of Newfoundland on a S.W. course in 46° latitude; then pass about sixty miles South of Sable Island, and from thence make for the desired port.

In these passages it is recommended never to pass northward of Sable Island, on account of the frequent fogs met with in those regions and strong S.W. currents that are found near it, the effects of which cannot be foreseen.

Routes from Europe to the Ports of the United States.—Passages from Europe to the United States are much retarded by the Gulf Stream, which should be avoided, for in case of contrary winds or calms an easterly set would be inevitable. In order to reach these ports, then, the routes previously indicated should be followed, passing southward of Sable Island, and from thence following in the southerly current which flows along the coast of the United States, in order to avoid that of the Gulf Stream. In all cases if this current is to be crossed to the westward it should be done as quickly as possible.

There is another route which, although longer as to distance, appears preferable; for if the time occupied in the passage might appear greater in consequence of the distance it is really less as to the speed with which the vessel would sail from port to port. This route is that of the trade winds. On leaving Europe, if the wind be not favourable to a direct route towards the ports of the

United States, it would be better to make good a course South or S.W., as the wind permits, in order to find the trade winds as quickly as possible. The best course to reach their latitude is either between the Azores and Madeira or Madeira and the Canaries. It would be better to avoid passing between these last named islands and the coast of Africa, because the trade wind there loses its force and direction. But a vessel when once in the region of the trade winds may pursue the most convenient course, according to her desired port, only being cautious as to making the land, and in crossing the Gulf Stream, so as to be about ten leagues or so to windward of her port.

There are, however, many circumstances under which this route can be made without the assistance of the trade winds, and they occur principally during the forty or fifty days after the two equinoxes, periods in which N.E. winds are frequently found; so that vessels sailing then may shape their course at once. Besides, if a vessel in the counter current of the Atlantic meet with contrary winds, it is better to make southing, in order to fall in with the trade, than to be striving against these winds. In the spring, summer, and autumn seasons, when the N.E. trade winds extend as far as 28° and 30° N. lat., the passage by the trade winds will be advantageous. Lastly, if the wind admits of it when going from Europe to the United States, West is the course to adopt; if not, and if at the time of the equinoxes, adopt that which is the nearest to it. In any other case we should prefer adopting a southern course, so as to attain the region of the trade winds.

On comparing the passages of ships made during six years between Liverpool and New York, it appears that the passage is made on an average in forty days. As a specimen of quick passages we may mention the following: the *Charlotte*, sailing from Bremen to New York, has made two voyages in thirty-three and twenty-eight days; the *Alexander*, starting from the Weser, has been twenty-seven days in reaching the same port; and the *Clementina*, starting from Bremen, has reached Baltimore in twenty-nine days.

Homeward Course from the United States to Europe.—In the homeward course from the ports of the United States to Europe, those currents which set to the southward should be crossed as quickly as possible, so as to gain the Gulf Stream and attain a northern latitude in order to get clear of this current, because it is frequently subject to bad weather; and in the months of July, August, September, and October severe weather is experienced in it. During the other months, however, probably a good vessel might keep in it, and would thereby much shorten her passage. When on the meridian of 42° W., the course should be directed so as to pass to the northward of the Azores; and from thence, according to the winds, to follow the course most convenient for reaching the port of destination. These passages are greatly assisted by West winds, veering to S.W. and N.W. In fact, the general passage made by sailing packets from New York to Liverpool, deduced from all the voyages made by them during six years, is twenty-three days. The same passages made by steamers present the following results:—

<i>From East to West.</i>	<i>Longest.</i>	<i>Shortest.</i>
<i>Great Western</i> , Bristol to New York.....	21½ days.	13 days.
<i>Royal William</i> , Liverpool to New York ...	21½ „	18½ „
<i>Liverpool</i> , Liverpool to New York	18½ „	16 „
<i>British Queen</i> , Portsmouth to New York...	20½ „	14 „

<i>From West to East.</i>		
<i>Great Western</i> , New York to Bristol.....	15 „	12 „
<i>Royal William</i> , New York to Liverpool ...	17½ „	14½ „
<i>Liverpool</i> , New York to Liverpool	17½ „	13½ „
<i>British Queen</i> , New York to Portsmouth...	22½ „	13½ „

In leaving Europe for the Gulf of Mexico or for ports of the Carribbean Sea, as soon as an offing is obtained the course should be S.W., in order to reach the region of the N.E. trade winds as soon as possible. In this part of the route care must be taken not to approach too near the coast of Africa, in consequence of the current and the wind becoming more westerly. If obliged to continue as far South as the Canaries to find the trade they should be left to the eastward.

A vessel once in the region of the trade winds, bound to the Lesser Antilles, may make directly for her port, keeping as long as possible on the parallel of 19° or 20° North latitude, from the month of May to December. From December to June, on the contrary, a more southern track should be followed. But in approaching the Antilles much allowance must be made for the current, as the reckoning will always place the vessel East of her true position. In such cases it will be well to add twelve miles a day to the westward course to allow for this current. If the vessel be destined for the Great Antilles or the ports of the gulf of Mexico she will enter the Carribbean Sea between Guadaloupe and Antigua,

or between Isle St. Martin and Culebra. This is invariably the entrance chosen in voyages to St. Thomas, Porto Rico, Kingston, Havana, Tampico, Vera Cruz, and New Orleans. When bound to La Guayra, Porto Bello, Cartagena, or any of the ports of Venezuela, vessels generally pass between St. Lucia and St. Vincent. Vessels bound for Guiana should keep in shore and to the South of their destined port on account of the currents.

Routes from Europe to Guiana.—On leaving Europe for Guiana, the general route, from November to July, will be to cross the parallel of 10° N. lat. in the most direct line between the meridians of 48° and 50° W., in order to cross the zone of calms to the West of the most difficult part. Having reached the parallel of 10° they would keep a point or a point and a half further South to meet the effect of the general current setting N.W., so as to attain, at about fifty leagues from land, the parallel of 3° or $3^{\circ} 30'$ N. latitude. A westerly course, until in about eight or ten fathoms, might be adopted for the coast. From July to November the following course might be better adopted and sometimes with advantage. Passing 150° leagues to the West of the Cape Verd Islands, steer South, so as to cross the zone of the variables, and reach the S.E. trade, which at this season is felt as far as 5° and 6° or even 7° or 8° N. latitude. Having found the S.E. trade, a westerly course between the equator and $3^{\circ} 30'$ N. lat. would make the coast in a depth of six or eight fathoms.

Vessels from the Lesser Antilles bound to Europe generally pass between Guadaloupe and Montserrat.

From thence, with East and N.E. winds, it is best to make northing in order to get clear of the trade winds as soon as possible. When the zone of the variable winds is attained, a ship should proceed as previously directed in the homeward routes from North America to Europe. Vessels from Jamaica generally pass between St. Domingo and Cuba, and thence between Inagua and Crooked Island. If bound to the Lesser Antilles a vessel should steer between the North coast of St. Domingo and the S.E. shore of the Bahamas. From thence, avoiding the wind, she could reach the Lesser Antilles sooner than by plying to windward in the Carribbean Sea. Vessels from La Guayra, Porto Bello, or Cumana for Europe leave the Carribbean Sea by the Mona Passage, formed by the isles of St. Domingo and Porto Rico. From thence they proceed to the N.E., in order to cross the parallel of 40° N. latitude between the meridians of 30° and 35° W. longitude.

Ships leaving Porto Rico proceed directly North, in order to pass the region of the trade winds, following nearly the same route. On leaving Cuba or the ports in the gulf of Mexico, vessels pass up the Bahama Channel and thence steer to N.E. to leave the stream. They then proceed eastward, passing South of the Bermudas, and again cross the Gulf Stream in the neighbourhood of the Azores.

Vessels leaving certain ports of Costa Firma for the Lesser Antilles, will perhaps derive advantage from adopting the Bahama Channel instead of contending against the wind in the Carribbean Sea.

Outward Voyage.

Elbe to Havana	59 days
Hamburg to Guayra	50 „
Channel to St. Domingo	46 „
Channel to Vera Cruz	40 „
Channel to Antigua	27 „

Homeward Voyage.

Havana to Elbe	49 „
Jamaica to Channel	32 „
Havana to Gibraltar	47 „
Vera Cruz to London	42 „
Guadaloupe to Channel	33 „
Port Prince to Channel	30 „
St. Thomas to Hamburg	45 „

Routes from Europe to South America.—Vessels leaving Europe for the ports of South America, such as Rio Janeiro or Buenos Ayres, ought to steer about South-West to fall in with the N.E. trade wind as soon as possible, passing between the Azores and Madeira, or between Madeira and the Canaries, and to the West of this archipelago, unless required to stop here. Thence they would proceed to cross the line, traversing the zone of the variable winds.

Crossing the Line.—It has been for some time the rule to cross the line in 22° or 25° W. longitude. Numerous facts have proved it preferable to cross it between 25° and 30° W. In fact, between these meridians the zone of the variable winds of the equator is less extended than it is towards the coast of Africa, and it is frequently passed without experiencing calms from the N.E. and S.E. trade winds.

Their change is frequently accompanied by stormy weather. As to the fear of being drawn towards the West and towards Cape St. Roque by the equatorial

current, it would seem that this has been much exaggerated and also that the trade winds in this part blow more from the East than they were supposed to do, so that Cape St. Roque may be doubled without any difficulty. As a general rule it may be stated that the winds from the sea on the coast of Brazil blow nearly always at right angles to the line of the coast, principally from October to March. During this period, then, the coast may be approached without fear, the winds being generally from N.E. to E.N.E., and the current near the coast setting from North to South thereby, as observed, assisting the passage. From March to October, on the contrary, the winds coming from East to E.S.E. and the current near the coast setting from the southward, it will be preferable to keep forty or fifty leagues from the coast, in the current of the coast of Brazil, and pass westward of Trinidad in order to reach Rio Janeiro and Buenos Ayres.

Vessels bound to the Pacific by Cape Horn, whether sailing from Rio Janeiro or Buenos Ayres, or coming from the northward, should keep at a distance of 100 miles from the coast of Patagonia, in order to avoid a high sea, caused by the West winds which prevail there, and to profit by the changes of the wind on the coast. They will then pass between the Falkland Islands and Terra del Fuego—that is if they are bound for the Pacific—and will generally pass East of Staten Land, the strait of Lemaire being often difficult to adopt. The courses to be taken in leaving the ports of South America differ according to the latitude of these ports.

Homeward Voyage from South America to Europe.
—Vessels from the ports of Brazil to the northward of

the point of Olinda may generally stand along the coast on the starboard tack and direct to the northward. Those leaving any port of Brazil to the southward of that point are generally obliged to get on the port tack, to avoid the coast and make a board to the southward. Sometimes the N.E. winds oblige them to continue on this tack for twelve or fourteen days, and standing to the S.E. and S.S.E. as far as 28° or even to 32° S. latitude. This tack should be kept as far as 32° W., so that on standing to the northward on the starboard tack a vessel may be certain of reaching to windward of the isle of Trinidad. As the vessel proceeds northward the wind will be found more easterly, admitting a slack bowline, or it would be extraordinary if she does not weather Fernando de Noronha, crossing the line between the meridians of 32° and 37° W. From thence the zone of the variables of the equator, generally West of the meridian of 32° , will be crossed, and the starboard tack is kept through the N.E. trade as far as 30° N. latitude. Once beyond the region of the trade winds, the course must be shaped according to the destination, passing northward of the Azores.

After these observations concerning the ports of Brazil, there will be very little difficulty as to the course to be pursued in leaving the southern ports or coming from Cape Horn. The West winds which prevail in this zone will facilitate a vessel's progress to the limits of the S.E. trade.

According to fifteen voyages made from different ports of Europe to Rio Janeiro, the mean duration of the voyage is found to be fifty days. Several voyages have been made from the West coasts of France and England

in forty and forty-two days. Packets leaving Rio Janeiro for England generally make the passage in thirty-five days.

Outward Voyage.

The Channel to St. Catherine.....	77 days.
Straits of Gibraltar to St. Catherine	53 "
Havre to Maranhao	43 "
Marseilles to Rio Janeiro.....	65 "
Bordeaux to Cape St. Augustine	45 "
Bordeaux to Cape St. Antonio	64 "
Rio Janeiro to St. Catherine	6 "
Channel to Montevideo	57 "
Channel to Cayenne	31 "
Europe to Cape Horn.....	82 "

Homeward Voyage.

Montevideo to Rio Janeiro	11 "
Rio Janeiro to the Channel.....	58 "
Ports in the North of Brazil to Europe..	33 to 37 "
Montevideo to the Channel.....	83 "
Maranhao to the Channel.....	65 "
Cayenne to the Channel	56 "
Cape Horn to Rio Janeiro	18 "
Cape Horn to Europe	73 "

The foregoing will suffice to give a general idea of the voyages from Europe to the coasts of South America. Let us now proceed with those from Europe to that part of the coast of Africa situated North of the equator.

The masters of vessels from the English channel must bear in mind what has been said in regard to the currents of those parts. After having doubled Cape Finisterre, according to the time of year, at a distance of thirty-five or sixty leagues, a vessel should steer between South and S.W., giving the coast of Portugal a wide berth, especially during winter, in order to pass East or West of Madeira or to reach the Canaries, which are

always sighted by vessels on their passage to the coast of Africa. These islands may be passed on either side, the channel between them and the African coast presenting no danger which is not apparent. If it is desirable to pass through them, the preferable channel is that between Palma and Hiero on the West and by Gomera on the East.

It is rarely after having passed to the southward by the other channels that calms are not met with, along with a swell which endangers the masts, under the lee of the large islands of the archipelago. This is especially the case with the wind from the North and N.E., which, interrupted by them, does not reunite in a steady course till far to the southward. In November and December it is preferable in bad weather to pass clear away to the westward of these islands in case of meeting the S.E. winds, which are frequent at that time.

If desirous of touching at the Canaries, the best anchorage for a ship is that of Palmas, North of the Grand Canary. The town there offers more resources than those of Santa Cruz, in Tenerife, and the bay is easy to leave under sail in all weathers; which is not the case at Santa Cruz, a harbour generally frequented though very dangerous with a S.E. wind.

On leaving the Canaries, a vessel bound to the coast southward of them will adopt a South, S.W., or S.S.W. course, according as she may have passed outside or through one of the channels of the group. Having passed the parallel of 19° at the southern extremity of the bank of Arguin, she would gradually haul to the eastward till getting thus into the North polar current,

in which she would keep her course. St. Louis should be made a little to the northward of its latitude. If bound for Goree, a vessel should pass round Cape Verd. When bound to places South of Goree, such as the Gambia or Sierra Leone, or even to the coast of Liberia, the route as far as Cape Verd will be the same; for a vessel must generally pass it unless leaving the Cape Verd Islands. In all these cases should a vessel not touch at the islands it is best to steer in such a manner as to pass nearer to Cape Verd than to the islands of that name, because the wind is steadier and fresher than on the coast. From Cape Verd the navigation depends on circumstances, being comparatively easy with N.E. winds in the fine season, but difficult with the S.W. winds of winter.

Vessels proceeding to places on the North coast of Guinea or to the isles of the gulf of Biafra or the Gaboon, after having left Cape Verd will make for Cape Palmas, either with the favourable winds from October to May, or with the contrary ones principally during June, July, August, and September, when they blow from S.W., W.S.W., West, and W.N.W., interrupted by calms. At this period it is best to keep 100 leagues from the coast. They will then steer so as to sight the cape or about twenty leagues or more to seaward of it. At this distance they will find the North Guinea current, which is only a continuation of the polar current of North Africa, setting to the East and E.N.E. from 15° or 16° W. longitude. After reaching the parallel of Cape Palmas, they will find, as already stated, the trade wind from S.W. and W.S.W. Winds with a current

will then be found favourable for reaching any of the places of North Guinea. But it must be observed that in these routes a vessel should pass further South than 2° N. lat., in order not to get into the equatorial current which sets to the westward. Thus as soon as the parallel of Cape Palmas is reached and the cape sighted by a vessel bound to the Gold Coast or the Ivory or Slave Coast, she should keep in the zone comprised between the coast of Guinea and 2° N. latitude.

The best method for a vessel to navigate this coast is to keep the land in sight, at about the distance of ten or fifteen miles, and to approach it to about the distance of one or two miles when thirty or forty miles West of her destination, taking great care not to run beyond it. In estimating the route it will be very important to consider the velocity of the current—which runs from twenty to twenty-four miles a day—for it is requisite to approach it well to westward of the point to which she may be bound.

If bound for the islands of the gulfs of Biafra or Gaboon, a vessel having doubled Cape Palmas should steer East, keeping between 3° and 2° N. lat. as long as possible, according to the island she is bound for. She should then cross obliquely the zone comprised between 2° N. lat. and the equator, running before the wind for her port, in order to make the land to the southward of it. The same must be done in going to the islands of the gulf of Biafra. In the vicinity of these islands the current of South Guinea is met with, setting to the N.E., and sometimes N.N.E.; then S.S.W. winds will be found, veering, perhaps, to South as the equator is

approached. In sailing from Princes Island to Gaboon the current of South Guinea is crossed, setting N.E., N.W., and sometimes North. It is therefore necessary, in going from Princes Island to Gaboon, generally to make the land to the South of this river in order to counteract the effect of the current.

In the bottom of the gulf of Biafra the currents are variable, although in the latitude of Fernando Po, and between this island and the coast, they generally set to E.N.E. and N.E. If from thence it is desired to proceed to the southward, a vessel should keep at a little distance from the coast of Gaboon, in order to profit by the alternate breezes and to take advantage of the tides.

The current of North Guinea formerly terrified seamen, for they supposed that having once entered the gulf they could not leave it without much difficulty. These fears, as will be seen, were groundless.

Leaving a place eastward of the North coast of Guinea, a vessel should stand well out on the starboard tack till she is clear of the Guinea current and has entered that of the equatorial; and, according to the time of year, she may cross the line to the southward for southerly winds. She may then get on the port tack, so as to reach well to the West of her port of destination, in order to allow for the effect of the current of North Guinea, which will be found in 2° N. latitude; and if she cannot make it so on this tack, she must go about in 2° N. lat. and stand out on the starboard tack again till she has gone far enough West to be sure of reaching the coast to the westward of that port. In a few days, by this method, the port will be gained. Vessels which

have endeavoured to get to windward on the coast of North Guinea, are sometimes thirty or forty days in reaching Grand Bassam from Cape Coast, and have been obliged to give up the attempt and stand out to sea.

On leaving Fernando Po, a vessel must make her way along the coast of Gaboon, profiting by the slants of wind and current, and consequently keeping near the coast until she has made southing enough to stand into the equatorial current. Leaving Princes Island she should take the starboard tack, with S.W. winds, and continue on that tack as far as the coast permits; she may then get on the port tack and thus get clear of the gulf of Guinea.

If intending to leave the gulf of Guinea, after reaching the equator she may keep to the southward, profiting as she may by winds from South and S.S.W. to S.S.E., till she reach the meridian of Cape Palmas, and in the case of intending to go to the northward, after reaching about 17° West, she may make for the Atlantic on a course according to her destination. Then, if returning to Europe, it will be best to leave the equator in about 23° W. and make to the northward, and afterwards pursue the same route as that indicated in returning from Brazil to Europe; but if near the equator West and N.W. winds are found, which is often the case during winter from May to September, the ship may then cross it in 17° or 18° W., and pass between the Cape Verd Isles and the coast of Africa. North of the Cape Verd Isles the N.E. trade will be found, which will enable her to proceed on the starboard tack. If returning to any point on the coast of Africa, Sierra Leone, Gambia, Go-

ree, or St. Louis, a northerly course must be taken in 16° or 17° W., and a course made good between the meridians of 22° and 28° W., in order to avoid entering into the polar current of North Africa until the parallel of the Bissagos is reached. This last course will be especially favourable from May to September, which is the winter season. Lastly, a vessel bound to the United States or the Antilles, should proceed North in 28° or 33° W. long.

Favourable Season for leaving the Gulf of Guinea.

—The most favourable season for leaving the gulf of Guinea is from May to December. A vessel is then seldom obliged to cross the line; the S.E. winds are generally well established at this period, and reach beyond the equator. But from December to May it is better to cross the equator, and proceed at least in $0^{\circ} 30'$ or 1° S. lat. By following the foregoing directions, a vessel will in a few days be clear of the gulf of Guinea. In order to enter it, a vessel should pass near Cape Palmas, and keep in the North Guinea current, between the coast and 2° or 3° N. lat.

But in order to leave the gulf of Guinea, as a general rule, a vessel should endeavour to reach the equator by the most direct route according to her longitude. From May to December she may keep on the equator, or a little North of it. During the other months it will be better to keep South of $30'$ or 1° lat., and to the westward as far as the meridian of 16° , 17° , or 23° W. long., according to the port of destination in the North Atlantic Ocean.

Passages.

North of Europe to Madeira	15 days.
Strait of Gibraltar to Madeira	4 to 5 "
North of Europe to the Canaries	16 "
Strait of Gibraltar to the Canaries	7 "
North of Europe to Cape Verd Islands.....	30 "
North of Europe to Senegal.....	18 "
North of Europe to Goree	20 "
North of Europe to Gambia.....	24 "

On the coast of Africa, South of Senegal, the length of the voyage, according to the season, will vary greatly. Thus, in the fine season 28 days are taken to go from Goree to Princes Island, and in the winter generally 36 or 38 days.

Returning.

Princes Island to Goree	38 to 40 days.
Gambia to Goree.....	3 to 4 "
Goree to Senegal	5 to 7 "
Senegal to Channel.....	30 to 40 "

There are some instances of this voyage having been made in 24 and 22 days.

Routes from Europe to Ports of Africa South of the Equator.—The routes from Europe to those ports of Africa situated South of the equator, are very different according to the latitude of these ports. They are distinguished as the *Great Route* and the *Little Route*.

The Great Route is that adopted to reach the Cape of Good Hope, and in general all the ports situated South of Cape Negro.

The Little Route is that which ships take to reach ports situated North of Cape Negro. The *Great Route* is however followed by many vessels bound to these ports. Vessels taking the great route, on leaving Eu-

rope will follow the directions given for the routes from Europe to Brazil; they will consequently cross the line between 23° and 28° W. Thence, profiting by the S.E. trade, they will shape their course for the isle of Trinidad. They will pass West of it, and making for the southward will find westerly winds and the counter-current of the South Atlantic. They will then make for the Cape of Good Hope, so as to cross the parallel of 30° S. lat. near 18° W. long. By following these routes vessels have been only 59 days in sailing from the English Channel to Cape Town. A similar route may be adopted when bound to places on the West coast of Africa North of Cape Negro. Thus, after crossing the line between 23° and 28° W. long., a vessel may take the port tack with the S.E. trade and stand on, so that when taking the other tack she may reach the coast to the southward of where she is bound to, and so counteract the effect of the African polar current setting N.W. along the South coast of this continent. But if destined for Benguela, Angola, or even a point North of Cape Negro, the course may be so modified, as above shown, so as to render the passage shorter.

On leaving Europe a vessel should shape her course so as to reach the trade winds as soon as possible, passing either West or East of Madeira and West of the Canaries or in the channels through those islands. Thence she would pass West of the Cape Verd Islands if in winter, that is to say from June to September. During the other months she would pass between those islands and Cape Verd, keeping closer to the cape than to the islands, because near the continent the winds from

N.E. and N.N.W. are fresher and better established in this season. Which ever passage is adopted, after having passed South of Cape Verd she would keep along the African coast, at the distance of sixty or eighty leagues, until the parallel of the Bissagos is passed. From thence she would steer for Cape Palmas, passing it at the distance of twenty leagues, and cross the gulf of Guinea on the starboard tack. This tack will generally enable her to reach Cape Lopez, and often South of the island of Anno Bon. She would then get on the other tack to look for the S.E. winds of the southern hemisphere, and, keeping in the space comprised between the coast and the line passing from the Cape of Good Hope to Cape Palmas, she would again get her starboard tacks on board to fall in with the S.W. winds which prevail there and blow alternately from sea and land from January to September. She would then keep near land to profit by them. The sea breeze lasts during day from ten or eleven o'clock in the morning, blowing from W.S.W. to S.W.; the land breeze lasts the night, from S.E. to South. She would therefore manage her boards in such a manner as to be near the coast for the land wind at night, and to be at a distance from it in the morning for the sea breeze. This navigation is similar to that on the coast of Senegambia in the northern hemisphere; but here the coast is much more extended and the season from January to September is particularly favourable for it. In the rainy season, near Cape Lopez squalls from the westward are sometimes met, but of short duration.

Routes from Europe to the Islands of the South

Atlantic Ocean.—Vessels from Europe to the islands of the South Atlantic Ocean have been sometimes a hundred days on their passage. The following remarks on this subject may prove useful.

To reach Ascension from the channel a vessel should gain the N.E. trade as soon as possible, and pass between the Cape Verd Islands and the continent or else West of the Cape Verd Islands. From thence she would steer so as to double Cape Palmas and make it if she can. As soon as she has lost the N.E. trade she should steer South to cross the zone of the variable winds without passing West of the meridian of 15° or 17° W. In approaching the limit of the S.E. trade winds near Cape Palmas, and even North of this cape, winds from the S.W. will always be found and sometimes from W.S.W. With these she should get on the starboard tack and cross the line in 5° or 6° W. long., or even more to the eastward if she would improve her speed with the currents of the gulf of Guinea. In this case she should make nearly the same course as shown for the islands of the gulf of Biafra, keeping on the parallel of 2° N. in order to reach the gulf of Guinea easily; then cross to the South, reaching Cape Lopez on the starboard tack. As soon as the South and S.E. winds are found she would get on the port tack and soon reach Ascension.

Routes to St. Helena.—There are two different routes from Europe to St. Helena. Considering the position of this island in the S.E. trade it cannot be reached from North without first standing away to the East or West in order to run down on it. The quickness of the passage will depend generally on the time occupied in

crossing the zone of the variable winds of the equator. The season will therefore determine which of the routes it will be best to pursue. The western route may always be taken. That of the East is only advisable during the months of November, December, January, February, and March,—a period when, as above said, the zone of the variable winds of the equator is diminished. The eastern route during the months just mentioned will be the same as that followed in going to Ascension, only the course should be prolonged towards the coast of Africa until the wind fails. The other tack is then adopted and St. Helena is generally reached by this route more quickly than by the westerly one. But when the sun has North declination the eastern route becomes very uncertain and the western is preferable. It may however be taken for granted that a smart sailing ship holding a good wind may adopt the eastern route in all seasons. After having crossed the line between 23° and 28° W. long. a ship adopting the western route will have to get on the port tack. This will take her towards the coast of Brazil, and she must generally tack nearer to it than to St. Helena. On the starboard tack she will then make to the S.E. as far as 23° S. lat., where she will put about again, standing N.E. and North, profiting by wind and current to the East of the isle, having passed South of it.

The currents near St. Helena are not strong, and when the wind is favourable there will be little trouble in reaching the bay, except during the syzgies, when the N.W. current prevails.

The average voyage from Europe to the Cape of Good

Hope is about ninety days. Horsburgh, in the *Anna*, made it in sixty-seven days; this is one of the shortest which has been made. A steam-vessel leaving England has reached the Cape of Good Hope in fifty-nine days. The general passage from Europe to St. Helena is sixty days.

Routes from Ascension and St. Helena to the Coast of South Africa.—St. Philip de Benguela being one of the southernmost places reached from Ascension on the coast of Africa South of the equator, we may adopt it, as from it all points to the northward will be easily attained. On leaving Ascension the starboard tack should be adopted, and in order not to fall into the great westerly current a vessel should endeavour not to pass North of the parallel of 4° S. lat., and also not to stand further South when the wind will not permit her to lay about S.E.b.S. true. This however will depend on circumstances. It will be easy to make a short board so as not to pass the above limits; but it will often happen that the passage may be made without tacking at all, because the winds in general along and near the African coast veer to S.W. and sometimes W.S.W. A vessel from St. Helena one can understand has only to lay her head for the point of the coast she is bound for, or something to the South of it, to allow for the polar current of the South Atlantic. And generally, notwithstanding the opinion of several authors who advise that on leaving these islands a vessel should take the port tack to get to the South and West when bound to a place on the coast of Africa as far North as St. Philip, we should take the starboard tack on leaving those islands,

and steer for our destination, allowing for the effect of the current, which flows, with a rapidity of fifteen miles in twenty-four hours, to the N.W. and W.N.W.

But leaving Ascension or St. Helena for a more southern part, the Cape of Good Hope for instance, a vessel should adopt the port tack to make southing and stand towards the American coast, profiting then by the remarks made concerning the routes from Europe to the Cape of Good Hope in the southern hemisphere.

Routes from the Coast of Africa to Ascension and St. Helena.—The routes from ports on the coast of Africa to Ascension and St. Helena have been shown in coming from places North of the equator; they are nearly the same as those followed in reaching them from Europe, whether the great or little route is adopted. When a vessel leaves the coast of Africa from anywhere South of these islands the winds and currents are favourable, and she should endeavour to make to windward of it, that is more to the southward than to leeward.

Homeward Routes from the North Coast of Africa to Europe.—In referring to the navigation of the gulf of Guinea the routes from thence to Europe have been alluded to. On reaching 23° W. long., standing to the South of the equator, a vessel should then commence her northing on the starboard tack and cross the zone of the N.E. trade winds. As soon as she has reached the zone of the variable winds she should make progress, passing to the North of the Azores or between them. A vessel starting from a point to the northward of Cape Palmas should get to the westward with S.W. winds which prevail in the vicinity of that cape, passing as

quickly as possible through the zone of the variable winds of the equator; she would then take the starboard tack with the N.E. trades and make her northing. A vessel leaving the ports of Senegambia, the Gambia, Goree, or St. Louis with N.E. and N.N.E. winds, during the fine season, would stand out on the starboard tack till she reached the zone of the variable winds. In the homeward routes from points on the West coast of Africa South of the equator that from the Cape of Good Hope to Europe may serve for the rest.

Route from the Cape of Good Hope to Europe.—On coming from the Indian Ocean round the Cape of Good Hope, if in the fine season, a vessel may approach the land without fear and steer North when the cape is passed. But if in the winter season, namely from June to September, before steering North it will be best to get an offing to the West of forty or fifty leagues from the land, in case of meeting with West and N.W. winds, which prevail during this season. After doubling the cape, in the fine season, namely from October to April, a vessel will pass near St. Helena, a short distance either to the East or West of it. From St. Helena she would steer N.W., in order to pass twelve or thirteen miles East or West of Ascension, and thence cross the line between 23° and 28° W. long. The route she would then take has been previously pointed out in returning to Europe. In the case of doubling the Cape of Good Hope between August and September a vessel should keep at a respectful distance from the coast and steer South of the zone of the S.E. trade winds in order to cross the parallel of 20° S. lat. on the meridian of about 18° W. long.

She would then endeavour to cross the line between 26° and 28° W. long. In this season the average of many passages from the Cape of Good Hope to Europe is seventy days; from the Cape to St. Helena generally fifteen days; and from St. Helena to Ascension generally six days.

Routes from the Ports of North America to the Coasts of North Africa.—From the ports of North America to that part of the coast of Africa North of the equator, the course at first is nearly the same as that for returning to Europe; but when a vessel has reached far enough to the eastward to make her port, she would then steer for that part of the coast, crossing obliquely the region of the N.E. trade winds.

Routes from North America to West Africa or South America.—When steering for any port of Africa South of the equator, she would cross the zone of the N.E. trades obliquely, and then the equator between 23° and 28° W. long., and take one of the routes previously indicated, either to the western coast of Africa or the eastern coast of America. In treating of the routes from the coast of Africa to the ports of North America, that from the Cape of Good Hope to these ports need only be pointed out, from which the rest may be easily deduced.

Leaving the Cape between October and April the prevailing winds will be found from S.E., and the course will be the same as that previously shown for returning to Europe until the equator is crossed in 28° W. From thence a vessel would pass West of the shoal called Penedo de St. Pedro and proceed with the trade winds

from East or E.N.E. in order to pass at a good distance to windward of the Lesser Antilles. This course, as may have been seen, presents no difficulty.

A ship rounding the Cape of Good Hope between the months of March and September, should avoid the coast on account of the N.W. winds, which blow with violence during the winter, and keep South of the zone of the trade winds in order to reach the parallel of 20° S. lat. in the meridian of 18° W. She would then steer northward and cross the line in 33° W. long. During this season it is preferable to cross the equator on this meridian rather than in a more eastern one. It is also better to pass East of the Bermudas if she should be bound to a port of Nova Scotia, instead of West of them, because at this period easterly winds are often found in those parts. The rule generally adopted is to pass East of the Bermudas from the middle of March till October in going to any port on the North coast of America situated North of New York.

From the different routes now pointed out it will be easy to design any that may be required from one point to another of the Atlantic Ocean.

A CONCLUDING GENERAL VIEW ON MAKING PASSAGES
IN THE ATLANTIC.

THE principles to be observed in making a passage between two places, whether under sail only or with the assistance of steam, are:—1.—Never to hug the wind when it is foul, but to let the ship go at least a point free through the water; and, 2.—To profit as much as possible by the well known prevailing currents of the several seas that are happily so distributed throughout them as to be favourable for the navigator in different latitudes when he is desirous of reaching either shore from any place, whether this be on the same or on the opposite coast; and 3.—To lay the ship's head on that tack, with a foul wind, that will enable her to look best up for her port.

All currents are more or less influenced by the wind. Before therefore commencing with the mode of making passages, it may be as well to take a rapid view of the prevailing winds which are to regulate the seaman's course across those seas.

Within the tropics the prevailing wind is generally easterly; to the northward of the equator as well as to the southward of it, it draws slightly towards either pole according as the sun retires from it. These winds, called the Trade winds, prevail throughout the equatorial regions of the Atlantic and Pacific Oceans; but in the Indian Ocean they are modified by the great African

continent,—by which their character is totally changed ; and according to the position of the sun (as they generally blow towards it) they become monsoons or periodical winds, but still subject to certain modifications.

The surface of the globe between the tropics and either pole is the region of the variable winds ; generally assuming a contrary direction to the trade winds, to contribute, perhaps, with other phenomena to preserve the atmospheric equilibrium or counterpoise that is found in all the operations of nature. But the whole subject of atmospheric changes, like that of natural history generally, is replete with those beneficial arrangements of an all-wise Creator in anticipation of the wants of his creature man to reach readily the different parts of the globe which he inhabits by the aid of navigation. So that he may turn to his account the winds and the currents which again and again change their directions with the seasons of the year. All is ceaseless change, perpetually working to his good,

Such is the reflection resulting from a general view of the winds ; their several peculiar modifications will appear as we proceed and have to allude to them in showing the manner of making the several passages on which we propose to treat.

A ship leaving the British Channel for any port to the southward should first gain a good offing, and then shape her course according to the wind, modifying it according to that which may be expected as she proceeds. In crossing the bay of Biscay it was customary in former days to make an allowance for what was considered the indraught to the eastward ;—but modern

navigators have shown that the reason of ships finding themselves to the eastward of their reckoning in proceeding southward, has arisen more probably from the deviation of the compass caused by local attraction. Much however will depend on the direction of the wind and how it has previously been. If it has been to the northward of West, the great body of waters accumulated in the bay may be looked for as finding an escape to the westward along the North coast of Spain, and thence off Cape Finisterre to the S.W., eventually joining the Portugal current running to the southward. But even this is itself influenced by the wind which has produced a northerly current there as strong as that to the southward. Again, if the wind be to the southward of West the accumulated waters of the bay may be expected to run to the northward, and thence occasion an easterly set along the North coast of Spain.

Thus a vessel bound to a port on the Spanish coast in the bay will endeavour to make the land to the eastward or westward of it according as she may have had the wind, so as to make the land to windward of it or not (by the previous winds experienced) of that port. But for a vessel bound to the southward of Cape Finisterre a S.W. course is recommended in order to shut out the British Channel, and to reach fine weather as soon as possible. And having gained the latitude of 45° , should the vessel be bound to Oporto or Lisbon it might be well to make the land about Cape Toriñana, as by route A, and close with it if going to the former port. If to the latter, the vessel will make the best progress she can to the southward with a good offing of 30 to 60 miles from

the coast, and make the rock of Lisbon from whence she will gain her port. If bound to Gibraltar or up the strait she will still be in a good position for that destination. The passage from the Channel to Lisbon or the Straits will vary from four or five days to a week or more, depending much on the direction of the wind.

In the case, however, of a vessel bound southward, as soon as she has reached the parallel of 45° in about 12° West, she would shape her course direct for Madeira, as by route B, or if not desiring to touch there, for the Canary Islands. In case of going to Madeira, Porto Santo should be made, and from thence the East end of the island will be passed and Funchal Roads will be gained. In the case of a vessel stopping at the Canaries, she will probably round Point Anaga, and anchor off Santa Cruz. The anchorage off Palma is preferred to that of Santa Cruz, as having, it is said, more resources and being easy to leave, while the latter anchorage is much exposed to S.E. winds, and is not so easily left as Palma. But if it be not desired by a vessel to touch at any place on her way southward she may continue her course, passing to the East or West of these islands and reach the trade wind as soon as she can. She will generally be more certain of a breeze by passing to the westward of the islands. The passage to Madeira from the Channel is considered to occupy about a week.

Continuing her progress to the southward on the eastern side of the Atlantic, should a vessel be going to the coast, the Cape Verd Islands may be her next place of call, for which a S.W. course will be proper. In this route there is nothing to observe upon further than that

she has more chance of a breeze by keeping her distance from the coast. In June the passage inside the Cape Verd Islands may be taken, on the meridian of 20° W., with advantage.

If bound to the Gambia or Sierra Leone, whether from the Cape Verds or the Canary Group, the ship would endeavour to make Cape Verd as by the inner route c, from whence she would have the current and wind in her favour, and make the land to windward of her port. From either of these places, if required, the route to any part of the coast is easy by keeping within the limits of the easterly current, the shortest distance of which from the coast is about seventy miles off Cape Palmas: and in this manner, by keeping in this Guinea Current along the shore, as in route d, or the westerly current in the offing outside of it, passages are made to and from ports as far as Fernando Po and Princes and St. Thomas Islands. But to the southward of those ports to reach places on the coast, as the prevailing wind all the year is between S.W. and S.S.E., then a ship must get to the southward of her destined port with a good offing, and allow for a northerly current also while she is standing in for the coast on the starboard tack, taking care always to make it to the southward or windward of the port to which she is proceeding. And this observation refers to the whole extent of the coast to the southward, but as the cape is approached N.W. or S.W. and even S.E., winds will be mostly found, the latter especially being very heavy.

A vessel bound to Ascension from the Canary Islands from November to February inclusive, would do well to

make good a course so that she would pass about midway between the Cape Verd Islands and the coast, as in the inner route c. Passing these islands she might with advantage avail herself of the Guinea current to help her down to the N.E. of that island, along route d, and would thence stand across the equatorial current to the southward and make Ascension with the S.E. trade. If bound to St. Helena from thence, she must stand on across the trade and get into the zone of the variable westerly winds to the southward of its latitude, as shown by route e, and navigate so as to reach to the S.E. of the island, from whence she would run down to it with the prevailing S.E. winds. But in the other months a ship bound to Ascension or St. Helena, might do better by taking the route c across the equator in about 20° , and standing to the southward to about 15° S., so as to be able to lay some points to windward of it with the S.E. trade, making it with a fair wind from the southward. And in the same manner St. Helena would be gained, as shown from the route c or that of e from Ascension.

A vessel bound to the Cape should make the best of her way to the southward by routes b and c, which will take her as far as the Cape Verd Islands. From them she would cross the equator in 25° to 30° West, standing across the S.E. trade, and making the best of her way to the zone of the variables, crossing the parallel of 30° S. in about 15° to 20° West, (see route f,) where she will meet westerly winds, with which she will soon reach the Cape. This passage has been made to the eastward, but the S.W. winds near the coast met with as she gets to the southward, are so heavy as well as unfavourable that

she is unable to make so good a passage as by the route here pointed out.

Returning home from the Cape a vessel may shape her course by the route L, which will take her by St. Helena and Ascension, from whence she may cross the equator in about 20° W., and follow that route to the northward as the wind may permit, observing the maxim with which we set out, of letting the ship make her way a point free from the wind.

Passages to the western ports of the Atlantic from the Channel vary as to the mode of making them according to their position. Thus to ports of Nova Scotia, Newfoundland, or the St. Lawrence, the nearest distance is by the northern route, G, making good as far as 53° N. latitude, and then, as the coast is approached, there is the chance of making it with N.W. winds; while by standing to the southward at first, the whole force of the Gulf Stream current has to be met. But in shaping her course with a contrary wind, a ship should adopt that tack on which she will make most westing.

In crossing the Atlantic for any of the western ports, there are few months of the year in which a vessel may not expect to meet with ice. Happily the sea is less encumbered with it in the dark nights of winter than in summer, when there is so much more daylight that it is less difficult to avoid. Drifting down from the shores of Greenland and Labrador, it is most commonly found in the Atlantic in the earliest part of our summer, and lingering far to the eastward to the last days of our autumnal quarter. But it is most abundant near the banks of Newfoundland, in some parts of which probably

much about the Virgin Rocks. Between these rocks and Newfoundland the ice is most abundant, completely lining the coast in the severity of winter, and followed up in the spring by the drift ice on which the seal fishery is followed. Eastward of the banks the commonly assigned limits to their dangers are 40° E. long. and 40° N. lat. see * on the chart. Solitary cases there have yet been of masses having been met with far to the eastward of this position, and therefore having commenced the passage across the Atlantic whether by the northern or southern route, the most vigilant look out is required to avoid running into them. It has been proposed by the American officer Lieut. Maury, for steam-vessels to make the passage by two distinct routes, one to be adopted by vessels from Europe to America, and the other by those from America to Europe. The chances of vessels running foul of each other would be lessened by this method, and it was proposed that the northern route should be adopted by vessels from Europe to America, and the other, about sixty miles to the southward, should be followed by those from America to Europe; a judicious arrangement, by which those vessels going West will be less within the effects of the Gulf Stream, while those from the westward will be always in a position to profit most by it.

A vessel bound to Halifax, following up the route e, will endeavour to make the land to the southward of her port, where a remarkable distinguishing feature, alluded to in the directions, enables her to recognize it, and thence how to approach it; but in making for New York or any port of the States, she will ascertain by

her thermometer when she is crossing the Gulf Stream. Nor must her commander be surprised at passing two distinct currents of warm water, which, having done a counter-current setting to the southward, will be found along the American coast. But in making the passage it is recommended not to pass to the northward of Sable Island, in order to avoid being set down by the tides into the bay formed by the two extremes of that island, slightly curving as they do to the northward. The passage to Halifax may occupy thirty days, while that to New York takes thirty-six days to perform; the return passages to the Channel generally requiring less.

A vessel bound to any of the West India Islands or ports of the continent within them, should make her way to the S.W., so as to pick up the trades near Madeira. She may probably have to touch at that island. But she will find the trade wind earlier or later when in its neighbourhood according as the sun has southern or northern declination. And she will make the best of her way to the S.W., shaping her course according to the southern or northern position of the island to which she is bound, as shown by the routes H and J. But if between May and December, she should keep as much as she can along the parallel of 19° N., and if between December and June, she should keep further South, taking care to make due allowance for the current, which will always place her ahead of her position by the reckoning, and will at least amount to about twelve miles per day. If bound to any of the large islands or the coast of Mexico, she would enter the Carribbean Sea between Martinique and Antigua, by route H, or if to

Cartagena or Porto Bello, she would pass on either side of St. Lucia, and fall into route *k*. Again, if bound to either of the ports of Guayana or Venezuela, she would shape her course by route *k*, so as to make the land well to the eastward of her port; taking care that she is not drifted past it by the current, which will be found to acquire strength as she nears the coast. But to do this a vessel should stand South across the N.E. trade and the variables, so as to reach the S.E. trade and edge away to the part of the coast according to the position of her port.

A vessel homeward bound from the West Indies would adopt the eastern route *o*, or the western ones *m* or *n*, by the Florida Stream, according as she is to windward or to leeward. Thus from St. Thomas or any of the Carribbee Islands, she would stand to the northward by adopting nearly the route *n*. If from Jamaica, she may either pass between St. Domingo and Cuba, along the Old Bahama Channel North of Cuba, or run to leeward round its western end and pass the Havana up the Florida Channel by the route *m*. This is obviously the homeward route for vessels from the gulf of Mexico, while those from Guayana and Venezuela may adopt the route *n*, those from the latter gaining it by passing through the Mona Passage between St. Domingo and Porto Rico,—or they may take that between Cuba and St. Domingo, and thence join the route *m*.

It has been observed by an officer of considerable experience in West India cruising that the probable best homeward route from Jamaica is by the windward passage between St. Domingo and Cuba, thence by the

Crooked Island Channel to the N.E., thus joining the route N. This is best adapted however to smart sailing ships; but that most generally adopted, especially when so far to leeward as Jamaica, is to run westward round the West end of Cuba and so up to the northward with the Gulf Stream, by the route M.

A vessel bound to any port of the northern coast of Brazil, will adopt the route K or F as far as the equator, from whence she would shape her course so as to be on the coast well to the eastward of the port to which she is bound, and be careful not to be set to the westward of it by the current. A vessel bound to Pernambuco or Bahia will equally observe the route F as far as the equator, always making the land to the northward of either of those ports, and allowing for the Brazil current, which runs along the coast to the southward. From October to March, when the sun is to the southward, the wind is directly on shore, and the current sets to the southward; but from March to October the current in shore sets northerly.

A vessel bound to Rio or Buenos Ayres, will continue on her route F, and approaching the coast gradually, will make it about Cape Frio, by which she will have all the advantage of the Brazil current. On leaving any of these ports for Europe, a vessel has to gain if she can the homeward route L, or to cross the equator as near it as she can, and gain it as she can, although she may not be able to do so even as far North as 30° lat. But to reach a port on the opposite coast of Africa, it is obvious that her proceedings must depend on the latitude of the port which she is leaving as well as that to which

she would proceed. It is clear that on any part of the Brazil coast she is dead to leeward of her destination, and she has to cross the Atlantic to the southward or the northward as most favourable to her.

The passage from Rio to the Cape is sufficiently favourable. A vessel will stand to the S.E., as on route P, and soon find variable winds, and as she makes southing along with her easting will pick up westerly winds, which will speedily carry her to the Cape on this route; and vessels from Bahia and Pernambuco for the Cape would follow a similar course, first not being afraid of making southing. In fact, having gained the region of southerly and S.S.W. winds between 20° and 30° S., a vessel may run in upon any part of the African coast that she requires to make. But if she be to the northward of Pernambuco, or even at Cape St. Roque, she must make the best of her way across the trade to the northward, making a detour, and reaching as high perhaps as the latitude of Madeira, till she finds the variables, in which she may make her easting, and thence run down and take any port she may require on the coast by the route C, already mentioned. Vessels from the African coast coming to the coast of Brazil, and desiring to return, should keep to the southward of Cape St. Roque, as the return passage from thence is incomparably shorter to the southward of the S.E. trade than to the northward of the N.E. trade, especially when the sun is to the southward of the equator.

It is to be observed that the several routes delineated on the chart and here referred to, are those expressing nearly the tracks which ships are recommended to

follow. But as their ability to do this will much depend on the wind that they may severally meet with, the different routes must be considered as merely meant for their guidance, to be followed as nearly as the winds will admit.



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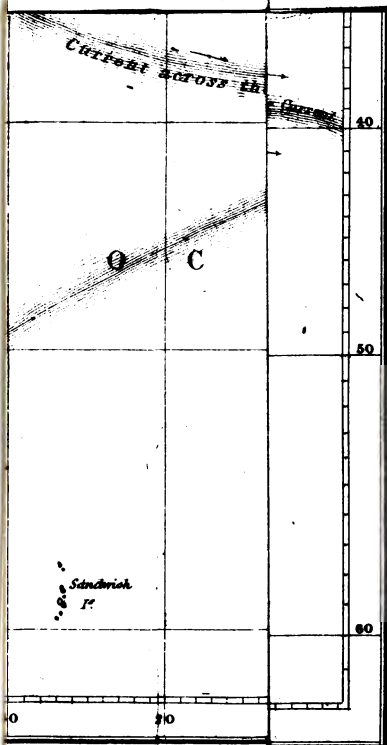
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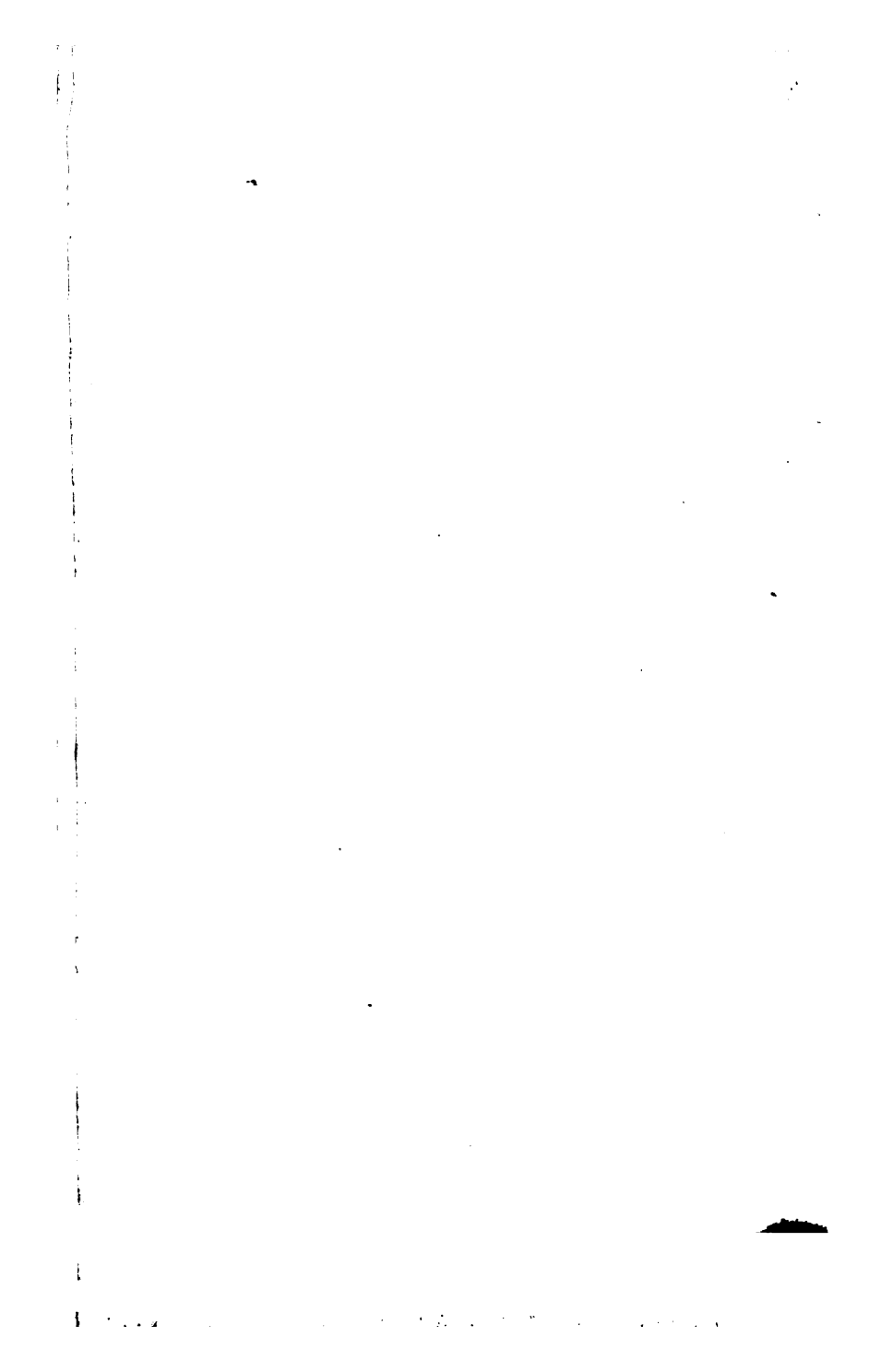
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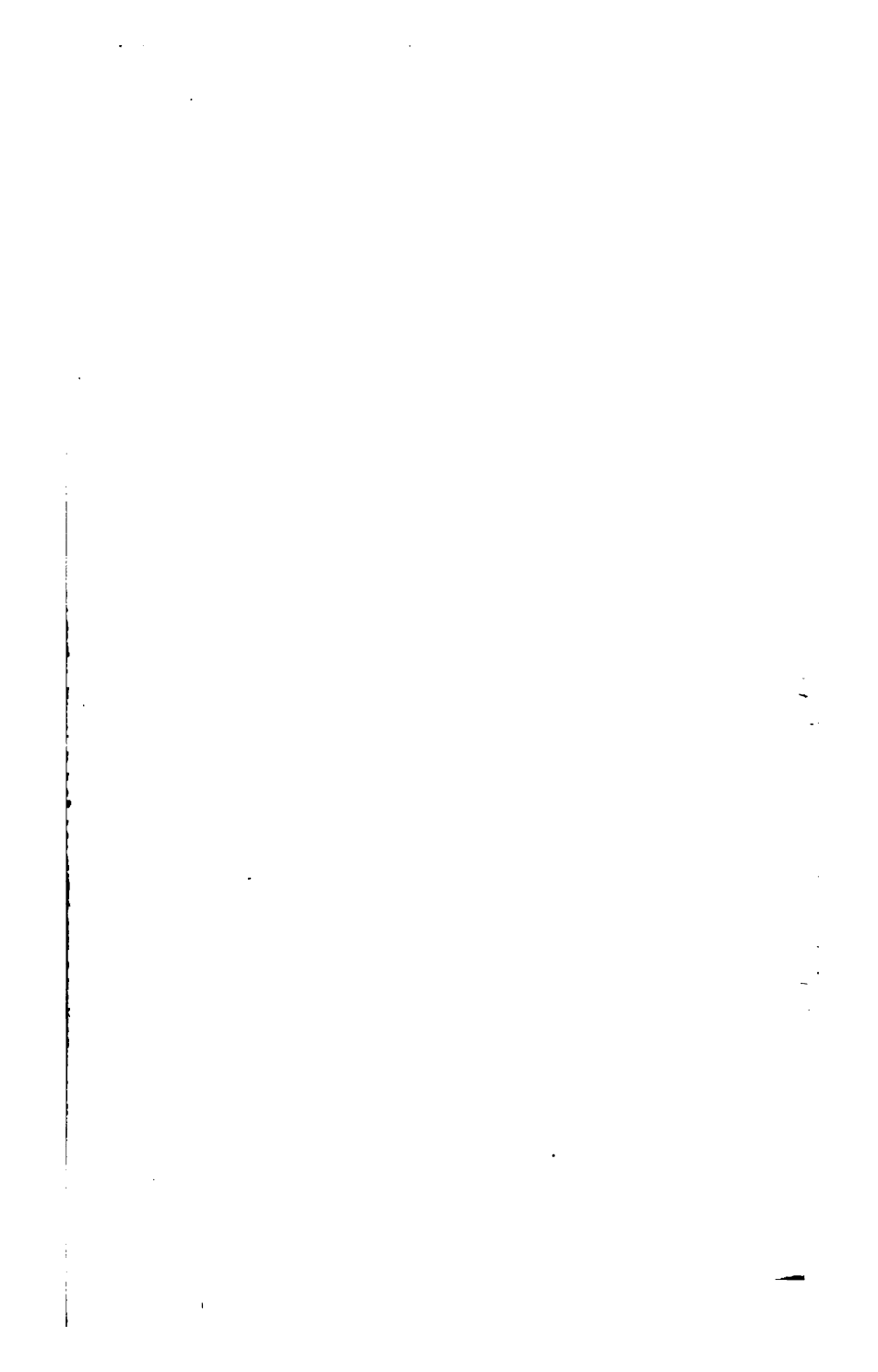
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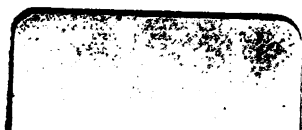
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